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REPAIR MANUALS

CORTINA III

Cortina Mk III
1300, 1600 OHV, 1600, 2000 OHC

from 1970 - 1976

repair manual 203

Brief History

OCTOBER 1970

The Mk III Cortina was introduced in complete contrast to the popular Mk II. Apart from a completely new body, a new range of engines was introduced at the same time including the 1600 GT and 2000 overhead camshaft engines. Independent front suspension was used with rack and pinion steering. 1600 GT and 2000 models were fitted with a full-width anti-roll bar. Alternator was standard on all models except the 1300 model. Automatic versions were also available except for the 1300. Dual brakes with servo assistance were fitted to the 1600 GT and 2000 versions and optional for all other models.

SEPTEMBER 1973

New single overhead camshaft engine was announced for the 1600 Saloon and Estate cars. A new close-ration gearbox was introduced for all 1300 and 1600 models. Anti-roll bars were now incorporated in both the front and rear suspensions. Two-piece, vibration-free propshaft introduced along with a redesigned interior, including modifications to the intruments, heating/ventilation and glove box. Rectangular headlamps were used on XL Saloons, Estates and GTS. 2000 cc engine was also available for XL Saloons and Estates.

New 2000E introduced incorporating all luxury features. Standard were halogen head lamps, vinyl roof, wood veneer dash panel and door cappings, centre console with clock, cloth upholstery, radio.

SEPTEMBER 1974

The 2000E Estate was introduced with specifications similar to the Saloon. Carpeted load space of 33.2 cu.ft. (64 cu.ft. with rear seat folded).

DECEMBER 1974

Specification improved on the 2000 GT models. Cloth trim upholsery and new style reclining seats with head restraints. Twin 5½ in. diameter halogen driving lamps and steel sports wheels with new style GT badge at rear. Cortina 'L' models had colour-keyed carpets and new style 'L' badge.

OCTOBER 1975

All Cortinas now had carpets, cloth seat trim, servo disc brakes, heated rear window, hazard warning lights and a cigar lighter. L models had new low level coachlines, driver's door mirror and rectangular halogen headlamps. Inertia seat belts were now standard.

FEBRUARY 1976

1300 models now had a revised engine fitted with the new Ford Sonic-Idle carburettor offering up to 15% better fuel economy.

Models Covered

1300 2 & 4-door Saloon
1300 Estate car
1600 2 & 4-door Saloon
1600 Estate car
1600 GT 2 & 4-door Saloon
1600 GXL 2 & 4-door Saloon
2000 2 & 4-door Saloon
2000 Estate car
2000 GT 2 & 4-door Saloon
2000 GXL 2 & 4-door Saloon
2000E
Automatic versions

Workshop Manual for

Cortina Mk III

1300/1600 ohv, 1600/2000 ohc

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intereurope WORKSHOP MANUAL for Cortina Mk III

2nd Edition
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Introduction

You are reading one of the best accessories that you could purchase for your car. Whether you are a keen do-it-yourself enthusiast or just eager to cut the cost of motoring, this repair manual will guide you through all the stages of various mechanical repairs - from a simple oil and filter change; fitting new brake shoes; checking the hydraulics; tuning the carburettor; dealing with the electrics; or even removing and overhauling the engine - all the knowledge and information you are likely to need are here!

The easy-reference contents page will guide you to the appropriate chapter section dealing with the part of your car to be checked or repaired. The photographs will show you what fits where giving you all the confidence to tackle a job for the first time. Each chapter contains easy-to-follow repair sequences with a comprehensive Technical Data section included at the end. If problems occur that can't be solved easily then turn to our special Troubleshooting charts for guidance.

A large proportion of this manual is devoted to routine and preventative maintenance with a complete chapter covering the servicing of your car - indeed, a money saver in itself!

Tools are of obvious importance to the do-it-yourself car owner and, like this repair manual, can be termed as a good investment. Purchase wisely, not over-spending but just purchasing good quality tools needed for a certain job and building up your equipment as you go. Tools required for general servicing aren't that many but it will be the wise do-it-yourself motorist who invests in a good jack and axle stands or wheel ramps. Some of the operations shown in this book require special tools and, in many cases, they can be hired locally. If specialist knowledge is required then we state as much. If it is possible to manage without special aids then we tell you how. Sometimes a little ingenuity can save a lot of time and money.

Now you can be the expert and the cost of this repair manual will be easily recovered the first time that you use it.

Jack Hay

Editor

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Routine Maintenance

GEARBOX/AXLE LEVELS
OIL FILTER
FAN BELT
AUTO. FLUID LEVEL
AIR CLEANER
BRAKES
CLUTCH
WHEEL BEARINGS
CONTACT BREAKER POINTS
IGNITION TIMING
SPARK PLUGS
VALVE CLEARANCES
ELECTRICAL
SERVICE DATA

On the opposite page can be found a detailed service schedule with a list of operations and checks to be carried out at certain intervals.

Most of the items are covered in detail under the appropriate chapter heading in this book. Some of the more regular operations are also covered in the following text with cross-reference to the appropriate section where necessary.

Remember that regular servicing is an important part of the preventative maintenance programme. Early troubles can normally be spotted and put right at relatively little cost when compared with the expense of fitting major components, usually needed because of previous neglect.

GEARBOX AND REAR AXLE LEVELS

It isn't necessary to change the gearbox or rear axle oil. At every large service interval the levels should be checked and topped up until the oil starts to overflow. Make sure that the surrounding area around the plug is cleaned first so that dirt or grit doesn't enter when the plug is removed. Always allow any surplus oil to drain from the filler hole before replacing plug. It is essential that this operation is carried out whilst the car is level. level, otherwise a false reading will result (Fig. 1).

If an excessive amount of oil is needed to bring the gearbox or axle to its correct level then find out why. Check for signs of oil leakage around each component. Put the leak right as soon as possible otherwise the leak may lead to a complete loss of oil and consequently a new assembly being required.

ENGINE OIL AND FILTER (OHV)

The oil filter element is of the throw-away cartridge type, and is screwed onto an adaptor on the underside of the oil pump housing. The filter should be renewed each time the engine oil is changed (Fig. 2).

1. Remove the sump drain plug, and allow the engine oil to drain into a suitable container, perferably while the engine is still warm. Wipe the drain plug clean and refit, using a new sealing ring if necessary. Tighten the plug securely.
2. Place a drip pan under the oil filter, and unscrew the filter canister from the pump housing. Clean the mounting face on the pump flange, and coat the sealing gasket on the new filter with engine oil. Screw the new filter canister onto the threaded adaptor by hand until the gasket just contacts the pump housing, then further tighten three-quarters of a turn.
3. Refill the engine with the recommended grade of oil. Run the engine up to normal operating temperature then, when the engine is at fast idle, check for oil leaks. Recheck the oil level, and top up as necessary. The oil filter as fitted to the OHC engine is a different design and is covered in the OHC Engine Chapter.

FAN BELT

Correct tensioning of the fan belt is important to ensure efficient operation of the cooling and electrical systems. Excessive tension will cause rapid wear of the belt, and place undue strain on the water pump and alternator bearings.

1. The belt is correctly tensioned when a total free movement of 13 mm (0.5 in) is present at the point midway between the water pump and alternator pulleys (Fig. 3).
2. If adjustment is required, slacken the alternator mounting and adjusting arm bolts, and move the alternator towards, or away from the cylinder block, as necessary, until the correct belt tension is obtained.
3. Retighten the adjusting arm and mounting bolts, and recheck the belt tension.

NOTE: The condition of the belt should be checked periodically. If nicked, cut, excessively worn, or otherwise damaged, the belt should be replaced. If the belt is noisy in operation, check for misaligned pulleys.

4. To replace the belt, proceed as for adjusting, but press the alternator fully towards the cylinder block, and detach the belt from the pulleys. Fit the new belt, ensuring that it is not twisted, and adjust the tension, as described above. Do NOT attempt to lever a new belt onto the pulleys, as this can easily cause damage to the belt or pulleys. The tension of a new belt should be rechecked after approx. 160 km (100 miles) use.

AUTO. FLUID LEVEL

1. Check the fluid level with the car standing on level ground and the gearbox at normal operating temperature.
2. Move the selector lever through all positions, then place it in 'P' and allow the engine to idle for two minutes.
3. The fluid level dipstick is located in the transmission filler tube, just forward of the engine compartment bulkhead. Clean all dirt from the dipstick cap and surrounding area, before removing the dipstick (Fig. 4).
4. With the engine idling and the selector in 'P', withdraw the dipstick, wipe it on a clean non-fluffy rag or clean paper. Re-insert the dipstick FULLY, and withdraw again immediately. Check the fluid level indicated on the dipstick. If necessary, add fluid of the recommended type to bring the level up to the 'Full' mark. The difference between the 'Low' and 'Full' marks on the dipstick is 0.6 litres (1.0 Imp. Pt.).

NOTE: Do NOT overfill the transmission, as this will cause the fluid to become aerated.

If for any reason it is necessary to check the fluid level with the transmission cold, the reading should be taken with the engine idling in 'P', as described above. However, in this case, the level should be approx. 9,5 mm (0.375 in) below the 'Full' mark, otherwise it will be too high at normal operating temperature when the fluid expands. The level should be rechecked when the gearbox is at normal running temperature.

NOTE: Periodic fluid changes are NOT required.

AIR CLEANER

The air cleaner contains a replaceable paper element. It is important that the air cleaner be serviced periodically, as a dirty element will restrict the air flow to the carburettor in-take, causing an over-richening of the fuel mixture, with a subse-

Service Schedule

WEEKLY OR WHEN REFUELLING

- Check and if necessary top up engine oil level
- Check and if necessary top up coolant level
- Check and if necessary top up brake fluid reservoir
- Check battery electrolyte level and top up if necessary
- Check and top up windscreen washer reservoir
- Check tyre pressures and condition-adjust pressures if necessary
- Check operation of all lights

EVERY 6,000 MILES (10.000 km) OR 6 MONTH INTERVALS

- Check and if necessary top up coolant level
- Check and if necessary to up brake fluid reservoir
- Check and if necessary top up windshield washer reservoir
- Check tyre pressures and condition - adjust pressures if necessary
- Change engine oil and renew filter
- Clean spark plugs and adjust gaps or renew if necessary
- Examine distributor points and renew if necessary, check and if necessary adjust dwell angle. Lubricate distributor, clean distributor cap, and coil tower. Clean HT leads and check for security
- Check ignition timing and adjust if necessary
- Check advance/retard mechanism operates
- Check carburettor idling and mixture settings - adjust if necessary
- Check and if necessary adjust valve clearances
- Check fan belt for tension and wear. Adjust if necessary
- Check tightness of generator or alternator mounting bolts. Tighten if necessary. Lubricate generator rear bearing (where applicable)
- Check battery electrolyte level and specific gravity - top up if necessary. Check terminal connections for tightness. Grease terminals
- Lubricate throttle linkage and adjust linkage or cable if necessary
- Check transmission fluid level and top up if necessary
- Check rear axle fluid level and top up if necessary
- Check for evidence of oil, water, fuel and exhaust leaks
- Check front brake pads for wear, examine rear brake linings and adjusting mechanism and clean (where applicable)
- Inspect brake system for leaks and hoses for chafing
- Check tightness of manifold bolts and exhaust down-pipe bolts, tighten if necessary. Check external condition of exhaust system
- Check steering linkage for wear/damage, security and condition of ball joint covers
- Check front suspension linkage for wear/damage
- Check clutch adjustment and adjust if necessary
- Check operation of all lights
- Check operation of door check straps, all locks and hinges and bonnet safety catch. Lubricate if necessary
- Lubricate handbrake linkage, adjust if necessary
- Check seat belts for security and wear
- Road test, or roller test with brake function test, including check operation of all instruments and controls
- Clean windscreen

EVERY 18,000 MILES (30.000 km) OR 18 MONTHS

As for 18,000 mile service plus additional items

- Change air cleaner element
- Clean crankcase emission valve and oil filler cap

EVERY 36,000 MILES (60.000 km)

As for 18,000 mile service plus additional items

- Clean and repack front wheel bearings and adjust
- Lubricate front suspension ball joints
- Discuss with your authorised dealer the advisability of renewing brake cylinder seals, flexible hoses and hydraulic fluid

Note: To maintain the anti-corrosive properties of the coolant it is recommended that every two years the cooling system should be drained, flushed and refilled with a 50% mixture of Motorcraft Anti-freeze Plus

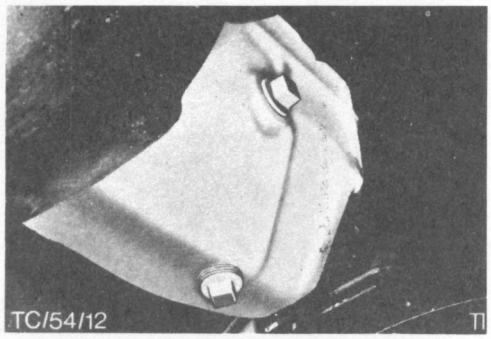


Fig. 1 Check the gearbox oil level

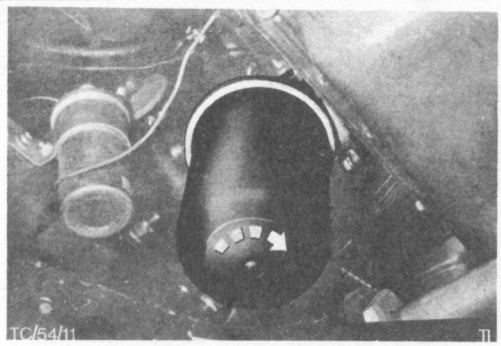


Fig. 2 Change the oil filter cartridge (OHV)

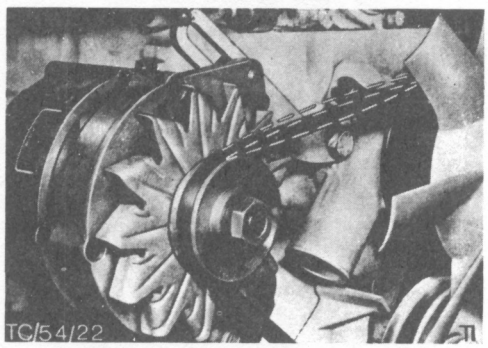


Fig. 3 Check the fan belt tension

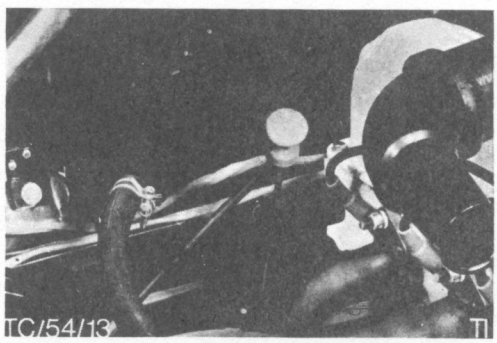


Fig. 4 Checking the automatic gearbox fluid level

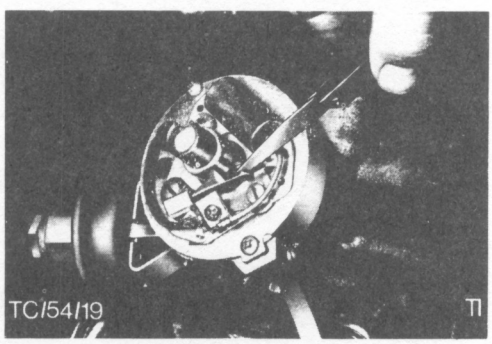
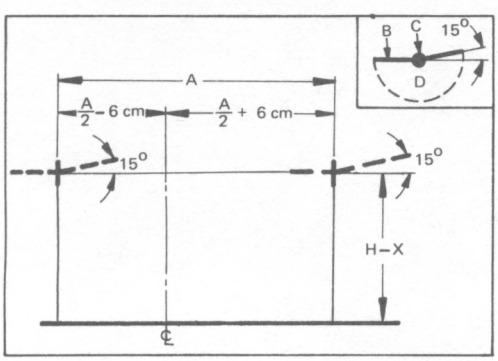


Fig. 5 Checking the contact breaker gap



A = *Distance between headlamp centres*

B = *Light/dark boundary*

C = *Beam centre dipped*

D = *Dipped beam pattern*

H = *Height from ground to centre of headlamps.*

X = *4.5 cm (1.75 in)*

Fig. 6 Headlamp alignment chart (left-hand drive shown)

For right-hand drive vehicles. The distance A/2 -6 cm and A/2 +6 cm should be reversed and the 15° beam inclination line should be transposed from right to left.

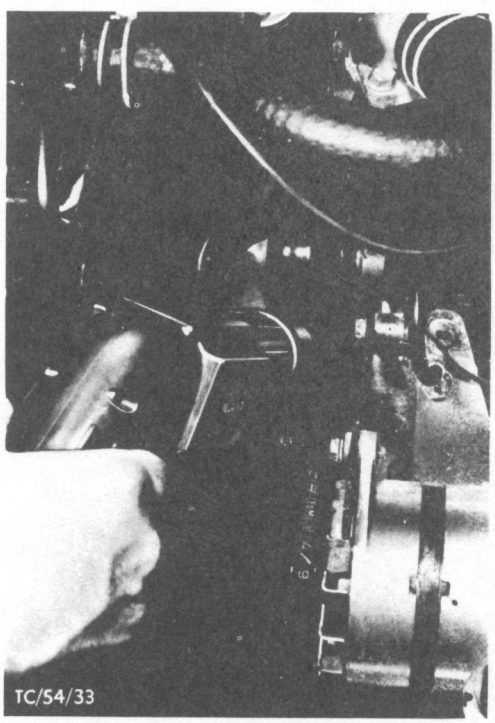


Fig. 7 Checking the timing using a stroboscope

quent increase in fuel consumption.

1. Detach the top cover, and lift out the filter element. Wipe out the inside of the cleaner body with a petrol-moistened rag. The element can be cleaned, by holding it vertically, and tapping it LIGHTLY to dislodge the dirt and dust. Rotate the element after each tap until the entire outer surface has been cleaned.

2. An alternative method of cleaning the element is to blow a stream of low-pressure compressed air through the element in the reverse direction to the normal air flow. Extreme care must be taken to avoid rupturing the element material.

NOTE: Under NO circumstances should the element be washed with solvent or cleaning solution. If dirty, split or torn the element must be renewed.

3. Inspect the element sealing gasket, and replace if worn or damaged. Ensure that the element is properly seated in the cleaner body and install the cover.

On some vehicles, the air cleaner spout may be swivelled towards the exhaust pipe to ensure a supply of warm air to the engine during cold weather. Turn the end of the spout until the 'W' (Winter) or 'S' (Summer) aligns with the arrow on the fixed portion.

CARBURETTOR

Adjustment of the carburettor on all models is cover in the Fuel System chapter.

FRONT BRAKES - Inspection

1. The front wheel must be removed to allow inspection of the brake pads. Check the pad lining for wear, by measuring the distance between the face of the pad backing plate and the adjacent contact face of the brake disc. If less than 3.2 mm (0.125 in) and never less then 1,6 mm (0.063 in), the pads must be replaced.

2. Inspect the pad linings for grease or brake fluid contamination. If present, the pads should be replaced. Grease may indicate a defective hub grease seal, and steps should be taken to inspect, and rectify the fault before fitting new pads. Brake fluid may indicate a defective caliper piston seal, and similar remedial steps should be taken. Always replace BOTH pads at BOTH front wheels to maintain braking balance. See Brakes.

REAR BRAKES - Inspection

The linings should be inspected for wear at 10,000 km (6.000 mile) intervals.

1. Raise the rear of the car, and support the axle on chassis stands. Remove the road wheel.

2. Ensure that the handbrake is fully released, then remove the brake drum. If the brake shoes are fouling the drum and preventing removal, remove the handbrake cable from the underbody brackets, and then remove the adjustment plunger assembly from the backplate.

3. Clean out the brake drum and lining, using a soft brush or clean cloth. Inspect the thickness of the linings. There should be at least 1.52 mm (0.06 in) depth of lining material, otherwise they should be renewed.

4. Inspect the linings for oil or brake fluid contamination. If present, the linings should be renewed. The presence of oil may indicate a defective axle shaft seal, and steps should be taken to inspect and rectify the fault before fitting new linings.

5. Brake shoes should be replaced in axle sets (i.e. BOTH shoes of BOTH rear brakes) to ensure correct functioning of the self-adjusting feature of the rear brakes.

It is recommended that exchange brake shoe assemblies be fitted as replacements, since the linings on these are correctly ground to match brake drum.

6. Inspect the wheel cylinder for signs of leakage. If present, the cylinder should be overhauled, or replaced immediately.

7. Examine the friction surface of the brake drum for scoring. Light scoring is permissible but serious scoring will increase lining wear, and in this case, the drums should be machined true, or replaced. If the wear pattern on the brake linings is uneven across the width of the lining, inspect the drum for "belling", and the back plate for distortion. Where one drum requires machining, it is advisable to cut down the drum on the opposite brake to the same size. See Brakes.

HANDBRAKE - Adjustment (Floor-Mounted)

1. Prior to adjustment, check that the cable follows its correct run, and is correctly located in the retaining clips. Operate the handbrake lever until the clicking sound of the adjuster mechanism ratchet at the rear brakes ceases (as applicable).

2. Place the handbrake lever in the "off" position.Check that the handbrake relay lever within the rear brake assemblies are in contact with the adjustment plungers.

3. This can be determined by checking that no perceptible movement of the plungers on the back plates can be felt.

4. Slacken the locknuts on the handbrake cable conduit at the R.H. abutment bracket.

5. Screw the nuts along the threaded sleeve to move the position of the sleeve relative to the bracket until all play in the handbrake cable is taken up (A clearance of 0.5 - 1.0 mm (0.020 - 0.040 in), measured at the adjustment plunger, should now exist between the relay lever and plunger, at each rear brake.

6. The cable can be moved by hand, from side to side, to even up the clearance if any bias is present due to friction in the system.

7. When the correct clearance is obtained at both rear brakes, tighten the cable locknuts. Check the handbrake lever operation. The brake effect at both rear wheels should be equal. Make sure that the rear brakes are not binding.

Dash-Mounted

8. Adjustment is effected in a similar manner as for the Floor-Mounted Control Lever, except that the front cable must first be adjusted as follows:

9. Slacken in the locknuts at the front cable abutment bracket on the R.H. side of the car. Adjust the position of the nuts on the cable threaded sleeve; until a clearance of 0,5 - 1,0 mm (0.020 - 0.040 in) exists between the front cable relay lever and the "off-stop" on the support bracket.

10. When the correct clearance is obtained, tighten the locknuts at the cable abutment bracket.

11. Adjust the rear cable, as described above for the Floor-Mounted Control Lever.

CLUTCH-Adjustment

1. Fully depress the clutch pedal twice, then allow it to return to its stop.

2. Pull the clutch cable forwards away from its abutment on the clutch housing and check that a clearance of 3.5 mm (0.14 in) exists between the adjuster nut and its abutment.

3. If necessary, slacken the locknut and screw the adjuster nut along the cable sleeve, until the correct clearance is obtained. Recheck the clearance after tightening the locknut.

FRONT BEARINGS - Adjusting

1. Raise the wheel clear of the ground.
2. Remove the hub cap, and lever the grease cap from the hub. Extract the split pin, and remove the nut retainer.
3. Release the hub nut several turns, then rock the wheel and hub assembly in and out a few times, to push the brake pad away from the disc.
4. Tighten the hub nut to 3.7 kgm (27 lb.ft) while rotating the wheel in its normal direction of rotation to seat the bearings. Slacken the nut back until an end-float of 0.03 - 0.13 mm (0.001 - 0.005 in) is obtained when a load of 9 - 23 kg (20 - 50 lb) is applied to the wheel.
5. Refit the nut retainer on the hub nut so that one set of slots are in line with the hole in the spindle, and secure with a new split pin.
6. Check that the wheel rotates freely without roughness, or drag. If not, the bearings should be cleaned and inspected, (see Front Suspension). If satisfactory, tap the grease cap into place, and refit the hub cap.

NOTE: Pump the brake pedal several times, to bring the pads into their correct operating position before driving the car.

CONTACT BREAKER POINTS - Adjusted

1. The contact points can be set, either by measuring the gap between the points with a feeler blade, or by measuring the dwell angle with a dwell meter. Where possible, and especially in the case of used points, the use of a dwell meter is recommended, as this is a more accurate method of setting the points.
2. Ensure that the faces of the points abut squarely. Any misalignment of the breaker points surfaces will cause premature wear, over-heating, and pitting. If necessary, align the points to make full-face contact by bending the fixed contact bracket. Do NOT bend the breaker arm.
3. Check the breaker arm spring tension, using a spring tension scale hooked over the moving breaker point. Pull the gauge at right-angles to the breaker arm until the points just start to open. If the spring tension is too great, rapid wear of the breaker arm rubbing block will result, causing the points to close up and retard the ignition timing. If the tension is too weak, points bounce will occur at high engine speed, resulting in misfiring. The breaker points assembly is of the pivotless-type, and should be replaced if the tension is not within specification.
4. To set the contact points gap using a feeler blade, remove the distributor cap and rotor arm. Crank the engine until the breaker arm rubbing block is resting on the highest point of the cam lobe (Fig. 5).
5. Slacken the fixed contact plate retaining and adjusting screws, and adjust the position of the contact plate until a gap of 0.64 mm (0.025 in) is obtained between the contact points. The feeler blade should pass easily between the contact without gripping. Recheck the gap after tightening the retaining and adjusting screws. Refit the rotor arm and distributor cap.
6. To set the contact points using a dwell meter, connect the meter in accordance with the equipment manufacturer's instructions. With the engine running at approx. 1,000 rev/min, read off the dwell angle indicated on the meter. This should be 39^{o} + - 1^{o}. If the dwell angle is outside the specified limit, adjust the points gap, as described above. If the indicated reading is below specification, the breaker gap is too small and should be increased. Similarly, if the reading is above the limit, the gap is too large and should be reduced. Recheck the dwell angle after adjustment of the points gap.

Replacement

1. Remove the distributor cap and rotor arm.
2. Slacken the retaining screw, and disconnect the primary and condenser leads from the contact breaker assembly.
3. Unscrew the retaining and adjusting screws, and lift off the contact breaker assembly.
4. Apply a light film of petroleum jelly distributor cam lubricant to the contact breaker cam. Distribute the lubricant uniformly over the cam surface so that, when the cam is rotated a small lubricant is deposited on the block of the contact heel.
5. Position the new contact breaker assembly on the breaker plate, and lightly retain in position with the two screws.
6. Connect the primary and condenser leads to the contact breaker assembly, and secure in position.
7. Check the alignment of the breaker contacts, and set the contact gap, as described previously.

IGNITION TIMING

The use of a stroboscopic timing light is recommended, to ensure accurate setting of the ignition timing. However, if the timing has not been previously set (i.e. after engine overhaul or re-installation of the distributor), the basic setting must first be obtained, as described below. In either case, the contact breaker points gap must be correctly adjusted before attempting to set the ignition timing.

Basic Setting

1. Turn the crankshaft until No. 1 piston is coming up to T.D.C. on the compression stroke. This can be determined by removing the spark plug from No.1 cylinder, and feeling the pressure developed at the spark plug hole.
2. Continue turning the crankshaft until the appropriate timing marks on the crankshaft pulley and timing gear cover are aligned. The initial setting is 4^{o} BTDC for all other engines.
3. Remove the distributor cap.
4. Slacken the distributor clamp bolt and turn the distributor body, as necessary, until the contact breaker points are just opening with the rotor arm pointing towards the No.1 HT contact in the distributor cap.

The opening point can be determined either by observing the spark when the points open, or by connecting a 12 volt test lamp between the distributor low tension terminal and a good earthing point, and observing the point at which the lamp just illuminates.

In both cases, the ignition must be switch on during this operation. When the correct setting has been obtained, lightly tighten the distributor clamp bolt.

Final Setting

1. Connect a stroboscopic timing light in accordance with the equipment manufacturers instructions (Fig. 7).

NOTE: No 1 cylinder is at the front.

2. Check that the appropriate timing marks on the crankshaft pulley and timing gear cover are visible. Mark with paint or chalk, if necessary.
3. Disconnect the vacuum line from the distributor.
4. Start the engine and allow to idle.
5. Point the timing light at the timing scale. The mark on the crankshaft pulley should be adjacent to the mark on the timing gear cover.
6. If the timing is incorrect, slacken the distributor clamp bolt and rotate the distributor body until the marks are a aligned. Recheck the setting after retightening the clamp bolt.
7. Remove the timing light, and reconnect the vacuum line.

SPARK PLUGS

The spark plugs should be removed and examined. When disconnecting the leads from the spark plugs, grasp the moulded cap of the wire, then twist and pull the cap off the plug. Do NOT pull on the wire, otherwise the connection inside the cap may become separated. Brush or blow any dirt away from around the plug, before removing. See Ignition Chapter.

VALVE CLEARANCES

Refer to the appropriate engine chapter for checking the valve clearances. The 1300/1600 OHV engines are covered on page 11 and the 1600/2000 OHC engines on page 29.

ELECTRICAL

At every large service all the electrical equipment should be checked. Details in fault-finding and general component overhaul is covered in the Electrical Chapter. Check that all lights are working and check headlamp alignment. Ideally this should be carried out using proprietary beam setting equipment. However, if this is not available then the procedure is as follows:

1. Position the car on level ground 3 m (10 ft) in front of a suitable aiming board (a white board marked with vertical and horizontal lines as shown in (Fig. 6), and placed in a suitably darkened area is recommended).
2. Ensure that the vehicle is unladen and the tyre pressures are to specification, bounce the front of the car to ensure correct settlement of the suspension and then measure the height 'H' from the ground to the centre of the headlamps.
3. Mark the centre of the front and rear windows with glass crayon and position the board at right angles to the car so that:
   a. the vertical centre line and the marks on the windows are exactly in line when viewed through the rear window of the car and,
   b. the horizontal line is at height 'H-X' from the ground.
4. Adjust each headlamp by means of the vertical and horizontal adjusting screws located inside the wheel arch as follows.
5. Cover one headlamp to prevent glare when adjusting the opposite lamp.
6. Adjust the horizontal position of the headlamp until the point 'C' is in the same vertical plane as the cross on the aiming board.
7. Adjust the vertical position of the headlamp so that the light/dark boundary of the beam pattern just touches the dotted line shown on the aiming board.
8. Repeat operations 5-7 for the other headlamp.

Service Data

TUNE-UP SPECIFICATIONS	1300 (OHV)	1600 (OHV)	1600 (OHC)	2000 (OHC)
Cubic capacity	1263 cc	1588 cc	1593 cc	1993 cc
Firing order	1-2-4-3	1-2-4-3	1-3-4-2	1-3-4-2
Contact breaker gap	0.025 in (0.64 mm)			
Dwell angle	38 - 40°	38 - 40°	38 - 40°	48 - 52°
Sparking plug gap	0.025 in (0.64 mm)			
Sparking plug type	Motorcraft AGR22	Motorcraft AGR22	Motorcraft BF22	Motorcraft BG32
Static ignition timing	6° BTDC	6° BTDC	6° BTDC	4° BTDC
Engine idle speed*	780 - 820 rpm	780 - 820 rpm	725 - 775 rpm	675 - 725 rpm
Valve clearances inlet:	0.010 in (0.25 mm) hot		0.008 in (0.20 mm) cold	
exhaust:	0.020 in (0.50 mm) hot		0.010 in (0.25 mm) cold	
Valve adjusting sequence	refer to appropriate engine section			

**NOTE: See "FUEL SYSTEM" for carburettor application.*

FAN BELT	
Total free play	0.5 in (13 mm)
CLUTCH	
Pedal clearance	6.5 in (165 mm)
TYRES	
Pressures	refer to "Quick Reference Data"
RECOMMENDED LUBRICANTS	
Engine sump	SAE 10W/40, SAE 10W/50
Gearbox	SAE 80 EP
Automatic Transmission	Ford fluid M-2C33-F
Rear axle	SAE 90 hypoid oil
Braking system	Ford brake fluid ESEA-M6C-1001-A
Fuel system	97 octane for HC, 91 octane for LC

CAPACITIES				
Engine sump (with filter)	6.16 Imp.pts. (3.5 ltrs.)		6.6 Imp.pts. (3.75 ltrs.)	
Gearbox	1.6 Imp.pts. (0.9 ltrs.)		2.4 Imp.pts. (1.35 ltrs.)	
Automatic transmission	11.25 Imp.pts. (6.4 ltrs.)			
Fuel Tank	11.9 Imp. Gallons (54.0 Litres)			

Engine 1300/1600 ohv

GENERAL
ENGINE OVERHAUL PROCEDURES
CYLINDER HEAD
VALVE CLEARANCES
CRANKCASE VENTILATION SYSTEM
OIL FILTER
OIL PUMP
FRONT COVER OIL SEAL
FLYWHEEL
ENGINE REMOVAL AND INSTALLATION
SUMP
TIMING CHAIN
CRANKSHAFT REAR OIL SEAL
PISTONS AND CONNECTING RODS
CAMSHAFT
TECHNICAL DATA

GENERAL

1300 and 1600 Series models are fitted with a 4 cylinder, in-line O.H.V., push rod engine. This engine is supplied in two capacities: a 1263 cc. version used in the 1300 Series, and a 1588 cc. version used in the 1600 Series. Each capacity is also available in high and low compression ratio versions.

Although of similar basic design, the main components (i.e. block, head, crankshaft, connecting rods, pistons, etc.) differ between the two versions. However, many of the ancilliary components are common. The increased capacity of the larger unit is obtained by lengthening the stroke, with a corresponding increase in block height, the bore remaining constant for all engines.

The cylinder bores are normally machined directly in the cast-iron cylinder block, but liners may be fitted in service. The cylinders are provided with full-length water jacketing and number from the front. The upper-half of the crankcase is integral with the cylinder block, and carries the cast-iron crankshaft in five main bearings. Crankshaft end-float is controlled by two half-thrust washers, located in the cylinder block on either side of the centre (No. 3) main bearing. The 'I' section, drop-forged steel connecting rods have separate big-end caps retained by two bolts. The aluminium alloy pistons are of the solid-skirt type, and are fitted with three piston rings - two compression and one oil control-situated above the piston pin bore. The combustion chamber is machined in the piston crown and different pistons are used for each engine capacity and compression ratio. The piston pins are fully-floating, and are retained in position by circlips installed in grooves at each end of the piston pin bore.

The cast-iron camshaft runs in the R.H. side of the cylinder block, in three white metal bearings, and is driven at half engine speed, by a single-row timing chain from the crankshaft. Chain tension is adjusted automatically by a mechanical tensioner device, comprising a spring-loaded snail cam and a pivoted tensioner arm. Chilled cast-iron cam followers are carried in individual bores immediately above the cam lobes. The fuel pump, ignition distributor and oil pump are driven from the camshaft; the former by an eccentric, and the others by a skew gear.

The cast-iron cylinder head is of the cross-flow type with vertically mounted valves. The valves operate in guide bores which are normally machined directly in the cylinder head, but separate guides may be fitted in service. The valves are actuated by cast-iron rocker arms and tubular steel push rods, the rocker arms being mounted on a common tubular steel rocker shaft with four aluminium support pillars. The rocker assembly is enclosed by a pressed steel rocker cover which incorporates the oil filler. The cast aluminium, water-heated inlet manifold is mounted on the R.H. side of the cylinder head, with the cast-iron exhaust manifold on the opposite side.

The engine lubrication system is of the pressure-feed type and incorporates a full-flow oil filter (Fig. AA:1). The eccentric bi-rotor type oil pump is mounted externally on the R.H. side of the cylinder block, and is driven by a skew gear on the camshaft. Oil is drawn into the pump through an oil pick-up pipe pressed into the cylinder block lower face and fitted with a mesh screen to provide primary filtration. A spring-loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back into the sump through an oil return tube. All the oil discharged by the pump passes through the full-flow type filter before it enters the main oil gallery. A by-pass valve is incorporated in the filter to by-pass the filter element if it becomes clogged, thereby maintaining the supply of oil to the engine.

The positive crankcase ventilation system is of the semi-closed type, air being drawn in through the oil filler cap, and exhausted from the spring-loaded regulator valve after circulating through the engine (Fig. AA:2). A vent hose then directs the air to the inlet manifold. The flow of air through the system is governed by the position of the regulator valve which is actuated by the inlet manifold vacuum. During idle, the valve moves to the low-flow position, but, as the engine speed increases, manifold vacuum decreases and the valve moves to the fully open position.

ENGINE OVERHAUL PROCEDURES

Certain engine overhaul operations can only be carried out once the engine has been removed from the car, and these are dealt with in the latter part of this section, after "Engine Removal and Installation". All other operations can be performed either with the engine still installed or once it has been removed.

CYLINDER HEAD - Removal

1. Disconnect the battery negative earth lead.
2. Remove the bonnet.
3. Remove the air cleaner.
4. Drain the cooling system (see Cooling System).
5. Disconnect the radiator top hose at cylinder head water outlet housing.
6. Disconnect the lead from the temperature sender unit.
7. Disconnect the accelerator cable from the mounting bracket on the rocker cover, and the throttle control shaft from the carburettor.
8. Disconnect the fuel supply pipe, distributor vacuum line, and automatic choke hoses, or manual choke cable, at the carburettor.
9. Disconnect the water and vacuum hoses at the inlet manifold.
10. Disconnect the H.T. leads at the spark plugs, unclip the leads from the rocker cover and place aside.
11. Disconnect the exhaust pipe from exhaust manifold outlet.
12. Remove the rocker cover and gasket, and discard the gasket.
13. Release the rocker shaft retaining bolts evenly, and lift off the rocker assembly.
14. Lift out the push rods and retain them in their correct

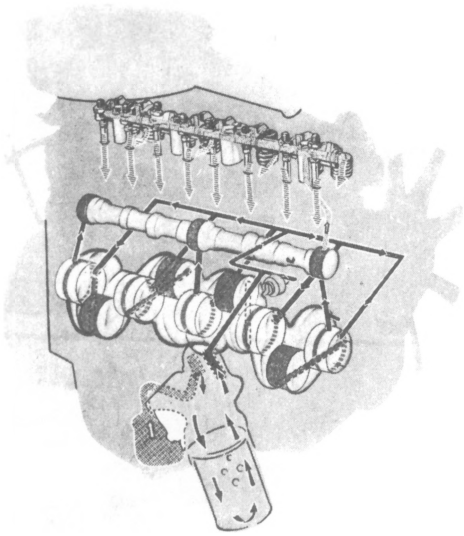


Fig. AA:1 Lubrication system

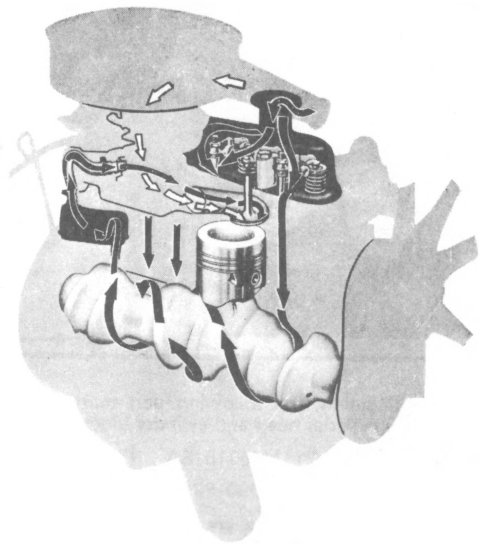


Fig. AA:2 Crankcase ventilation system

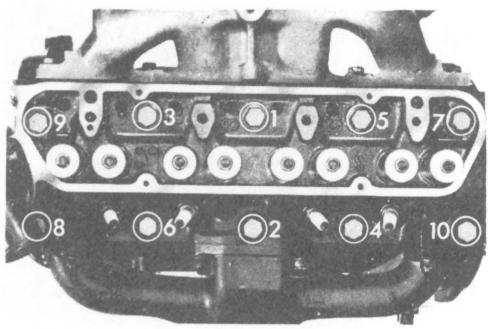


Fig. AA:3 Cylinder head bolt tightening sequence

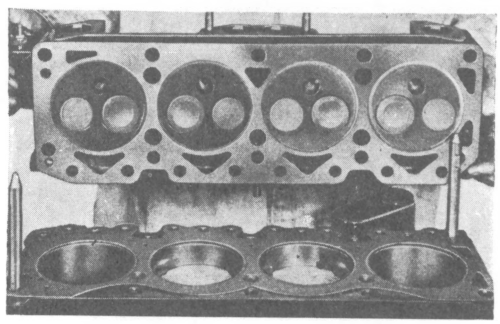


Fig. AA:4 Cylinder head guide pins

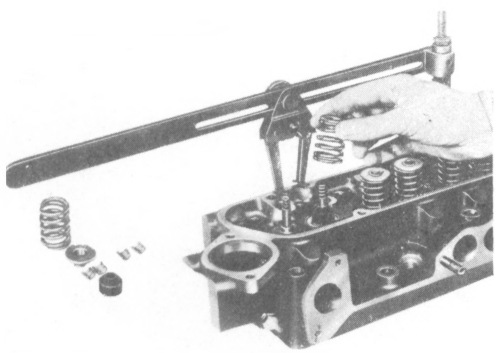


Fig. AA:5 Removing valve spring assembly

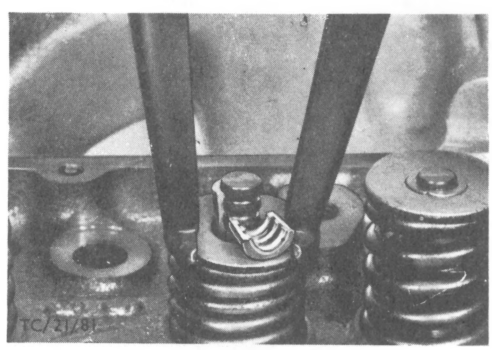


Fig. AA:6 Removing tapered collets from valve spring

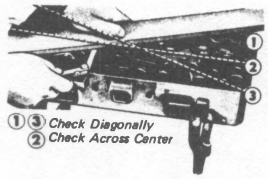


Fig. AA:7 Checking cylinder head flatness

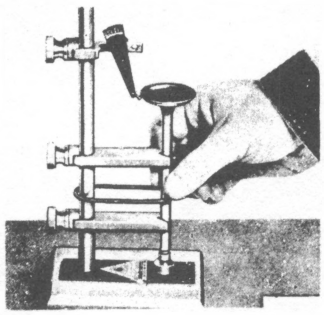


Fig. AA:8 Checking valve face run-out

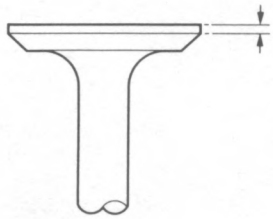


Fig. AA:9 Valve head thickness

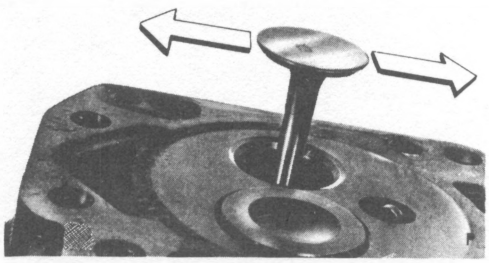


Fig. AA:10 Checking valve guide bore wear

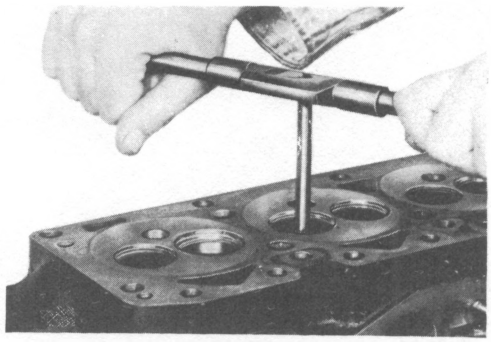


Fig. AA:11 Reaming valve guide bore

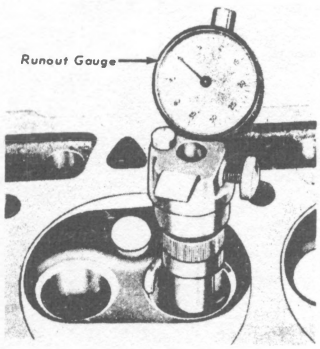


Fig. AA:12 Checking valve seat runout

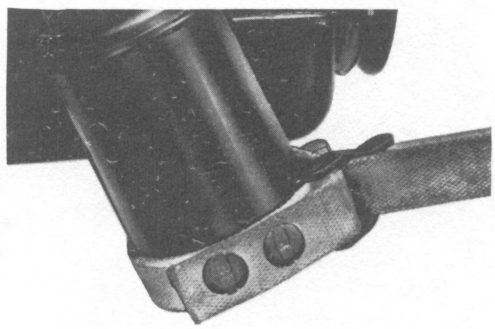


Fig. AA:13 Installing new oil filter

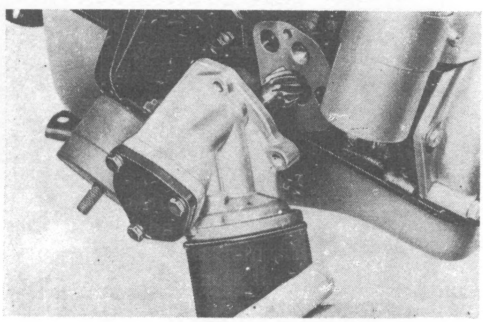


Fig. AA:14 Oil pump removal

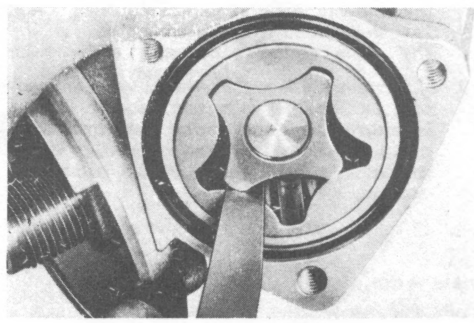


Fig. AA:15 Measuring pump inner to outer lobe clearance

order.

15. Remove the two retaining bolts, and detach the water outlet housing and gasket. Lift out the thermostat.

16. Release the cylinder head bolts evenly, in the reverse order to that shown in Fig. AA:3, and lift off the cylinder head and gasket. Discard the gasket.

Installation

Installation is a reversal of the removal procedure, with special attention to the following points:-

1. Ensure that all mating surfaces, especially those of the cylinder head and block, are perfectly clean and free from old gasket material.

2. If the cylinder head was removed to change the cylinder head gasket, check the flatness of the cylinder head and block before reassembly.

3. Use new gaskets where appropriate.

4. The use of two guide studs, made up and screwed into the cylinder head bolt holes, as shown in Fig. AA:4, will facilitate correct alignment of the cylinder head and gasket during installation. Once the head is installed, the studs are then replaced by cylinder head bolts.

NOTE: Do not use sealing compound of any type on the cylinder head gasket.

5. The cylinder head bolts are of different length, according to the varying height of the cylinder head. Ensure that the bolts are fitted in the correct respective positions.

6. Tighten the cylinder head bolts evenly, to their specified torque, in the sequence shown in Fig. AA:3.

7. Dip the ends of the push rods in engine oil prior to installation. Install the rods in their original positions.

8. Lubricate the rocker assembly with engine oil prior to installation. Release the rocker arm adjustment screws slightly before installing the assembly.

9. Ensure the rocker adjusting screws locate correctly in the cupped end of their respective push rods. Tighten the shaft retaining bolts evenly to their specified torque.

10. Check the valve clearances, as described in "Valve Clearances". The clearance should be rechecked with the engine at normal operating temperature.

11. When installation is completed, fill the cooling system, then start the engine, and check for oil, water, or exhaust system leaks.

Dismantling

1. Remove the spark plugs.

2. Remove the exhaust manifold.

3. Remove the inlet manifold, complete with carburettor.

4. Remove all deposits of carbon from the combustion chambers and valve head, with a suitable scraper and wire brush. Taking care not to scratch the cylinder head machined face.

5. At each valve in turn:-

a) Compress the valve spring, using a suitable compressor (Fig. AA:5).

b) Extract the two split tapered collets from around the valve stem. (Fig. AA:6).

c) Remove the oil seal from the valve guide boss, and withdraw the valve.

e) Discard the oil seal.

f) Identify all the components of the valve assembly.

6. To dismantle the rocker assembly, remove the split pin from one end of the rocker shaft, and detach the flat washer, crimped spring washer and second flat washer which bear against the end rocker arm.

7. The rocker arms, rocker shaft supports and springs can now be removed from the shaft.

NOTE: If necessary, the plugs can be removed from each end of the rocker shaft to facilitate cleaning, by piercing a hole in the plug and levering the plug out of the shaft.

Inspection and Overhaul

1. Clean all old gasket material, etc., from the machined faces, using emery cloth, if necessary. Remove all dirt, grease etc., with solvent.

2. Blow out all oil and water passages, particularly the oil transfer passage, with compressed air. Probe all bolt holes to ensure they are clear. If necessary, the holes can be cleaned out with a suitable size tap.

3. Inspect the head for cracks, and all machined surfaces for burrs, scratches, or nicks. Remove any burrs with an oil stone.

4. Check the cylinder head gasket surface for flatness, using a straight-edge (Fig. AA:7). If outside the specified tolerance, the surface should be planed or ground, but do not remove more than the specified amount of metal.

5. Check the spark plug holes for stripped or damaged threads. If present, it may be possible to rectify such damage with a suitable tap. Replace the cylinder head, if damaged in any way. Check the core plugs for leakage, and replace as necessary.

VALVE INSPECTION

The inlet valve head has a diffused aluminium coating. Under NO circumstances should the face of the inlet valves be ground or the valves be ground or the valves lapped in, as this will remove the coating and reduce the valve's wear and heat resistant properties. If the valve faces are worn or pitted, it will be necessary to install new valves and recut the valve seats or, alternatively, lap the valve seats using a dummy valve.

1. Inspect the valve head for signs of burning, erosion, cracking, or warpage.

2. Inspect the valve face and edges for pits, grooves, scores, or other damage. Measure the valve face run-out, as shown in Fig. AA:8.

3. On the exhaust valves, if the face run-out exceeds the specified figure, or if any other of the above faults are present, it may be possible to correct these conditions by refacing the valve to the specified angle.

NOTE: Remove only sufficient metal to correct the fault. If the thickness of the valve head edge is reduced to 0.79 mm (0.030 in.), or less, after grinding, the valve should be discarded, as it will run too hot in use (Fig. AA:9).

4. Inspect the end of the valve stem for grooves or scores. Minor damage may be removed by grinding, but do not remove more than 0.25 mm (0.010 in.) from the end of the stem. Chamfer the end of the valve stem, as necessary afterwards.

5. Check that the valve stem is not bent, and also the valve stem for wear. If excessively worn, the valve should be replaced.

NOTE: Valves are available with standard and oversized stems. The appropriate size should be selected dependent on the condition of the valve guide. Discard valves which are severely damaged.

VALVE GUIDES

After some length of operation, an oval wear pattern is produced on the valve spring end of the valve guide bore, at right-angles to the crankshaft axis.

1. Check the valve stem-to-guide clearance of each valve, in turn, in its respective guide, as shown in Fig. AA:10. If the clearance is excessive repeat the measurement using a new valve. If excessive guide bore wear is indicated, the guide should be reamed oversize, and a valve with a suitably oversize stem fitted (Fig. AA:11).

A reamer kit containing the necessary reamers and pilots is available. When reaming, always work from the valve seat end. Use the reamers in sequence, begining with the smallest reamer. Use paraffin as a lubricant.

NOTE: After reaming the valve guide bore, the valve seat MUST be recut to ensure the seat is concentric with the guide bore.

VALVE SEATS

1. Inspect the seating surface for pitting or burning. Check the valve seat run-out with an accurate gauge (Fig. AA:12). If the run-out exceeds the specified figure, or if any other of the above faults are present, the seating surface must be recut to the specified angle.
2. The seating surface must be recut when fitting a new valve, or after reaming the valve guide bore. The recutting of the valve seat should be closely co-ordinated with the refacing of the valve so that the finished seat and valve face will be concentric, and the correct interference fit will be maintained.
3. Remove only sufficient metal to clean up the pits and grooves, or to correct the valve seat run-out hard carbon deposits on the seat may be removed with a glaze breaker.

NOTE: Recutting of the valve seats can only be successful if the valve guide bore is not worn.

4. After the seat has been refaced, the seat width will probably be excessive. Check the width with a seat width scale.
5. If the seat width exceeds the maximum specified limit, it should be reduced using the appropriate size of cutter.
6. First determine where the valve seat contacts the valve face, by coating the seat with Engineers Blue and rotating the valve lightly on the seat. If the blue is transferred to the centre of of the valve face, the seat should be narrowed by removing metal from both sides of the seat. Blue from the top edge face indicates that metal should be removed from the chamber side of the seat with a top face cutter. Blue on the bottom edge of the seat indicates that it should be narrowed on the port edge.

The following sizes of cutters should be used:-

Valve Seat Angle	Top Face Cutter	Bottom Face Cutter
30°	15°	60°
45°	30°	60°

Valve seat inserts are available, and should be installed where necessary. Where inserts have not been installed previously, it will be necessary to machine an appropriate recess in the cylinder head.

If, for any reason, an existing insert has become loose or damaged, an oversize insert can be fitted. The necessary machining of the cylinder head and installation of the inserts should be entrusted to an Authorised Dealer or Specialist. After fitting inserts, the valve seats must be cut to the specified angle.

VALVE SPRINGS

Inspect the valve springs, spring retainers and locks for wear or damage, and discard any visually damaged parts.

Weak springs cause poor engine performance; therefore any spring which is approaching its wear limit should be discarded. When fitting new valve springs it is recommended they be replaced in sets. Ensure the replacement springs are of the correct rating.

PUSH RODS

Clean the push rods in solvent. Check the ends of the rods for nicks, grooves, roughness, or excessive wear. Check the rod run-out. Replace as necessary.

NOTE: Do NOT attempt to straighten a bent push rod. The push rods can be checked visually for straightness while still installed in the engine, by rotating them with the valve closed.

CYLINDER HEAD - Reassembly

Reassembly is the reverse order of dismantling with the following observations:

1. Oil the valve stem, and insert the valve into its respective guide.
2. Fit a new oil seal over the valve stem.
3. Position the valve spring and retainer over the valve stem.
4. Compress the spring, and install the two split-tapered collets.
5. Slowly release the compressor to engage the collets in the retainer taper and valve stem grooves.
6. If removed, install new end plugs in the rocker shaft and assemble the rocker shaft in the reverse order of dismantling.
7. The bolt hole in the rocker shaft support pillars must be on the same side as the adjusting screw in the rocker arms. The rocker arms are "handed" and must be fitted on the shaft with the rocker pads inclined towards the support.
8. Install the split pins with the heads upwards, and bend the legs to secure.
9. The manifolds can be refitted to the cylinder head either before or after fitting to the engine. Ensure the mating faces on the cylinder head and both manifolds are clean and free from old gasket material.
10. Apply jointing compound to both sides of the new inlet manifold gasket around the water jacketing port, then assemble the inlet manifold, complete with carburettor, to the cylinder head.
11. Fit the exhaust manifold, using a new gasket coated with jointing compound. Tighten the retaining nuts and bolts on both manifolds to their specified torques.
12. Fit the spark plugs and tighten to their specified torque.

NOTE: Once the spark plugs are installed, do not lay the cylinder head flat on its face, otherwise damage to the plugs may occur.

VALVE CLEARANCES

1. Remove the air cleaner from the carburettor.
2. Disconnect the spark plug leads, unclip them from the rocker cover and place aside.
3. Disconnect the accelerator cable from the mounting bracket on the rocker cover.
4. Disconnect the throttle control shaft from the carburettor.
5. Remove the four retaining screws, and detach the rocker cover and gasket. Discard the gasket.
6. Remove the spark plugs.
7. Rotate the crankshaft until each pair of the valves listed below in the first column are fully open, then check the clearance of the valves listed opposite in the second column. Valve numbering is from the front of the engine and adjustment is as follows:

Valves Open		Valve to Adjust	
Ex.	In.	Ex.	In.
1	6	8	3
4	2	5	7
8	3	1	6
5	7	4	2

The clearance should be:-

Inlet	0.25 mm (0.010 in)
Exhaust	0.50 mm (0.020 in)

The setting is correct when the appropriate thickness of feeler blade is a neat sliding fit between the valve stem and the rocker arm.

NOTE: Valve clearances should be checked when engine is cold, i.e.: not less than five minutes after engine has been switched off.

8. If adjustment is necessary, rotate the adjusting screw on the opposite end of the rocker arm until the correct gap is obtained.

9. When adjustment is completed, refit the rocker cover, using a new gasket, and reconnect the remaining items in the reverse order of removal. Adjust the cable, as described in Fuel System Section.

CRANKCASE VENTILATION SYSTEM

The crankcase ventilation system should be inspected and cleaned periodically. Remove the oil filler cap, and wash in low volatility, petroleum-based solvent. Probe the breather holes to ensure they are clear. Shake the cap dry, and refit. Do NOT dry the filter element with compressed air, as this may damage it. Clean the system connection on the inlet manifold by probing the inlet nipple with a piece of wire. Clean the regulator valve and system hoses with solvent, as above, and dry with compressed air. If excessively dirty or defective, the regulator valve must be replaced.

A malfunction in the crankcase ventilation system may be indicated by rough engine idle. Do not attempt to compensate for this condition by making carburettor adjustments or disconnecting the crankcase ventilation system, as removal of the system from the engine will adversely affect the fuel economy and engine ventilation, with resultant shortening of engine life. To determine whether the rough idle condition is caused by a malfunction in the system, exchange the regulator valve for a known good one, and compare the idle condition. If the condition persists, the valve is not at fault. Check the rest of the system for restrictions, and clean, as described above. If the malfunction still persists, further engine component diagnosis should be carried out.

OIL FILTER

The oil filter element is of the throw-away cartridge type, and is screwed onto an adaptor on the underside of the oil pump housing. The filter should be renewed each time the engine oil is changed.

1. Remove the sump drain plug, and allow the engine oil to drain into a suitable container, perferably while the engine is still warm. Wipe the drain plug clean and refit, using a new sealing ring if necessary. Tighten the plug securely.

2. Place a drip pan under the oil filter, and unscrew the filter canister from the pump housing. Clean the mounting face on the pump flange, and coat the sealing gasket on the new filter with engine oil. Screw the new filter canister onto the threaded adaptor by hand until the gasket just contacts the pump housing, then further tighten three-quarters of a turn (Fig. AA:13).

3. Refill the engine with the recommended grade of oil. Run the engine up to normal operating temperature then, when the engine at fast idle, check for oil leaks. Recheck the oil level, and top-up as necessary.

OIL PUMP - Removal

1. Remove the three retaining bolts, and withdraw the oil pump and filter assembly from the cylinder block (Fig. AA:14).

Installation

1. Using a new sealing ring, fit the oil pump and filter assembly to the cylinder block. Tighten the three retaining bolts to their specified torque. Run the engine, and check for oil leaks.

Overhaul

1. Unscrew the oil filter cartridge from the oil pump housing. Discard the sealing ring.

2. Unbolt the end plate, and extract the 'O'-ring from the groove in the pump body.

3. Check the clearance between the lobes of the inner and outer rotors (Fig. AA:15). If the clearance exceeds 0.15 mm (0.006 in), both rotors must be replaced, as they are supplied only as a matched pair.

4. Check the clearance between the outer rotor and the pump housing (Fig. AA:16). If the clearance exceeds 0.25 mm (0.010 in), the rotor assembly and/or pump body should be replaced.

5. Check the rotor end-float, by placing a straight-edge across the face of the pump body, and measuring the clearance between the straight-edge and the rotor. The clearance should not exceed 0.13 mm (0.005 in). If the end-float is excessive, the face of the pump body can be carefully lapped on a flat surface.

6. To replace the inner rotor and drive shaft assembly, remove the outer rotor, then drive out the retaining pin securing the skew gear to the drive shaft. Pull the gear off the shaft. Withdraw the inner rotor and drive shaft assembly from the pump body.

7. Fit the inner rotor and drive shaft assembly into the pump body. Support the drive shaft at the rotor end on a suitable spacer, and press the skew gear onto the shaft until the far end of the gear teeth are 57 mm (2.24 in) from the mounting flange (Fig. AA:17). If necessary, drill a 3.0 mm (0.12 in) hole at right-angles to the shaft through the gear shoulder, 33 mm (1.3 in) from the mounting flange. Fit a new retaining pin through the gear and shaft, and peen over the ends to secure.

8. Install the outer rotor in the pump body, with the chamfered face inwards. Fit a new 'O'-ring in the groove in the pump body, and assembly the cover plate, with the machines face towards the rotors. Fit the filter assembly, using a new sealing ring. Fit a new aluminium washer to the centre-bolt, and tighten to its specified torque.

FRONT COVER OIL SEAL

Replacement

1. Drain the cooling system, and remove the radiator.

2. Remove the drive belt, cooling fan and water pump drive pulley.

3. Remove the centre bolt and washer, and withdraw the crankshaft pulley, using a suitable puller or levers.

4. Detach the water pump from the cylinder block front face.

5. Remove the front four sump bolts and the bolts securing the front cover to the cylinder block. Detach the front cover.

6. Clean all old gasket material from the front cover, water pump, and cylinder block mating faces.

7. Support the front cover around the seal, and drive out the seal from the rear, using the Seal Remover Tool shown in Fig. AA:18. Take care to avoid damaging the cover bore.

8. Clean the bore in the cover, and inspect for nicks, etc.

9. Coat the new seal and the cover bore with grease.

10. Locate the seal in the cover bore from the rear with the sealing lip facing upwards. With the cover supported around the seal, invert the Remover Tool and drive the seal fully home. The use of the Remover/Installer Tool ensures that the seal protrudes the correct amount inside the cover.

11. Clean the oil seal contact surface on the crankshaft pulley with solvent to remove any corrosion, sludge or varnish deposits. Excess deposits that are not readily removed with solvent may be removed with emery cloth. Inspect the oil seal contact surface on the pulley for nicks, sharp edges, or burrs which might damage the oil seal during installation, or cause premature seal wear. If present, remove any such imperfections with emery

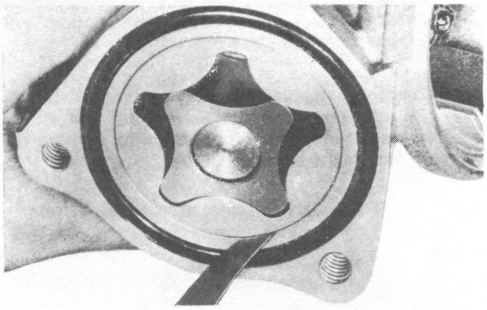


Fig. AA:16 Measuring pump outer lobe to housing clearance

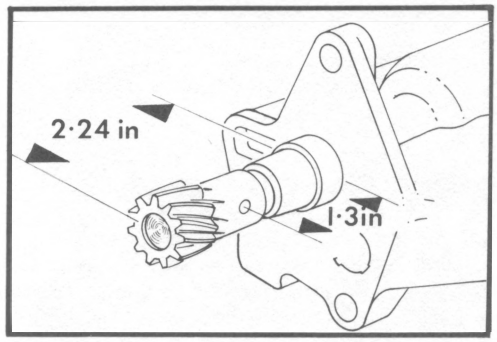


Fig. AA:17 Fitting dimensions for pump driven gear

Fig. AA:18 Removing front cover oil seal

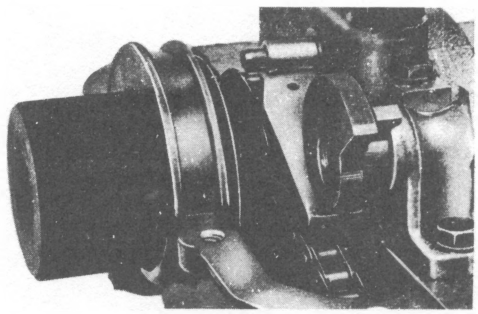


Fig. AA:19 Front cover alignment tool

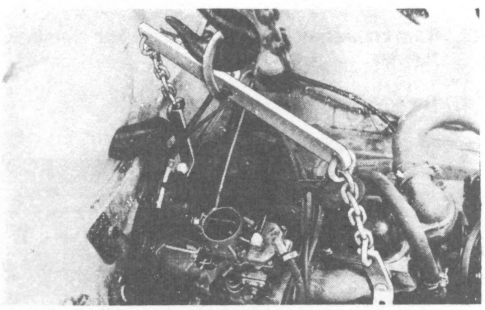


Fig. AA:20 Engine removal

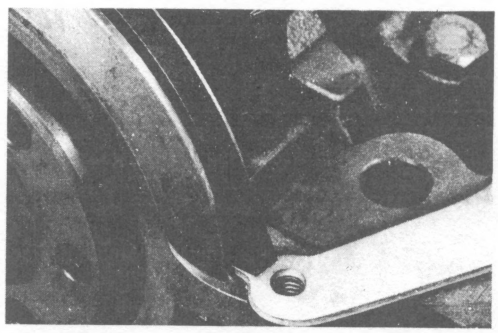


Fig. AA:21 Sump gasket correctly positioned

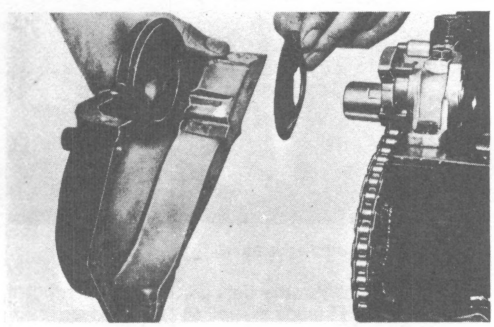


Fig. AA:22 Removing front cover and oil seal

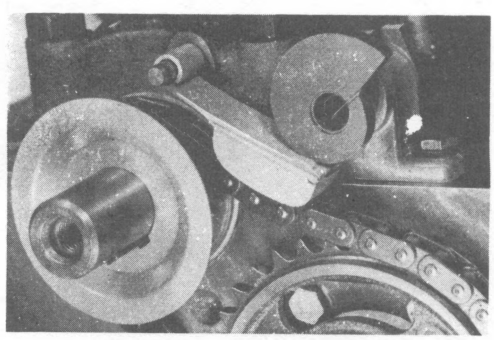


Fig. AA:23 Timing chain tensioner

cloth, but do not finish to the extent that the sealing surface becomes finely polished, as this may produce poor sealing.

12. Position a new front cover gasket on the cylinder block face. If the original sump gasket has been damaged, cut off the affected portion at the cylinder block face, and position suitable portions of new gasket on the sump face, with the sealing compound at the ends. Smear the gaskets with grease before fitting, to help location.

13. Fit a new cork packing strip to the bottom of the front cover with the chamfered end in the groove, using suitable jointing compound.

14. Install the front cover, align in position with the Cover Centraliser Tool, and tighten the cover retaining bolts to their specified torque (Fig. AA:19).

NOTE: Since it is most important that the oil seal is aligned concentrically with the crankshaft, if the Cover Centraliser Tool is not available, centralise the oil seal by inserting the crankshaft pulley.

15. Fit the removed sump bolts, and tighten to their specified torque.

16. Remove the Cover Centraliser Tool. Lubricate the sealing surface on the crankshaft pulley, and fit the pulley aligning the locating slot with the key in the crankshaft. Secure with the centre-bolt and washer.

17. Fit the water pump, using a new gasket, and tighten the retaining bolts to their specified torque. Note that the alternator adjusting arm is also secured by one of the pump attaching bolts.

18. Refit the water pump pulley, cooling fan and drive belt. Adjust the drive belt tension, as described in the Cooling System Section.

19. Install the radiator, and refill the cooling system.

20. Run the engine, and check for oil or water leaks.

FLYWHEEL - Removal

The flywheel can be removed either with the engine still installed or removed. If the engine is still in the car, the transmission unit must first be removed, and on manual transmissions, the clutch assembly detached from the flywheel. Refer to the appropriate section for details. Remove the flywheel retaining bolts, and gently tap the flywheel off the crankshaft flange.

Inspection

Inspect the clutch face of the flywheel. Blueing or small cracks are of no particular importance, but if there are any deep scratches, the flywheel should be machined down or replaced. If it is necessary to machine more than 1.44 mm (0.045 in), from the original thickness, the flywheel must be replaced.

Ring Gear

Inspect the ring gear for worn, chipped or cracked teeth. If the teeth are damaged or the ring gear radial run-out is excessive, the ring gear can be replaced on manual transmission models, but on automatic transmission models, the complete flywheel assembly must be replaced.

The ring gear radial run-out can be checked with a dial indicator. Locate the indicator with the stylus resting on a tooth of the ring gear. Adjust the indicator so that the stylus is near the extreme limit of its travel, to prevent the stylus point from catching between the gear teeth as the flywheel is turned. Zero the indicator. Slowly turn the flywheel through one revolution, and note the total indicator reading.

To replace the ring gear on manual transmission models, heat the ring gear with a welding torch on the engine side of the gear, then tap the gear off the flywheel. Take care to avoid hitting the flywheel during this removal operation. Alternatively, the ring gears can be removed by cutting between two adjacent teeth with a hacksaw, then splitting the gear with a chisel. Heat the new ring gear evenly until it has expanded sufficiently to install it on the flywheel. Do not heat the ring gear to a temperature in excess of 260°C (500°F) otherwise the temper will be removed from the gear teeth. Ensure the ring gear is seated properly against the shoulder on the flywheel, with the leading faces of the gear teeth relative to the direction of rotation. Allow the ring gear to cool naturally in air. Do NOT quench.

Installation

1. Ensure that the mating faces of the flywheel and crankshaft flange are perfectly clean and free from burrs.
2. Locate the flywheel squarely on the crankshaft flange, and tap into place.
3. Apply oil-resistant sealer to the threads of the retaining bolts. Install the retaining bolts, and tighten to their specified torque.
4. Check the flywheel run-out, as described above.

ENGINE REMOVAL AND INSTALLATION

1. Disconnect the battery and the engine earth strap.
2. Drain the crankcase and cooling system.
3. Remove the bonnet.
4. Remove the air cleaner.
5. Disconnect the radiator hoses at the engine. Remove the radiator, and shroud (where fitted).
6. Disconnect the exhaust down-pipe from the exhaust manifold.
7. Disconnect the following:-

a) Heater hoses at water pump and inlet manifold.
b) Alternator leads at alternator.
c) Starter cable at starter.
d) Accelerator cable from mounting bracket on rocker cover.
e) Down-shift cable from throttle control rod and mounting bracket (automatic transmission only).
f) Choke cable at carburettor (manual choke models).
g) Fuel tank line at fuel pump inlet. Plug tank line.
h) L.T. lead at ignition coil.
j) Oil pressure and water temperature sender unit leads at sender units.

8. Remove the starter motor.
9. On manual gearbox models, disconnect the clutch control cable from the release arm and abutment bracket.
10. Remove the clutch/converter housing to engine retaining bolts.
11. On auto. transmission models, remove the torque converter-to-drive plate retaining bolts.
12. Support the transmission with a jack.
13. Attach a suitable lifting fixture or sling to the engine (Fig. AA:20).
14. Disconnect both front engine mountings.
15. Raise the engine slightly to disengage it from the transmission, then carefully lift it out of the engine compartment.

Installation

Installation is a reversal of the removal procedure, with special attention to the following points:-

1. On cars with manual transmission, it may be necessary to turn the engine over slowly to allow the splines on the transmission input shaft to mesh with the clutch disc hub.
2. Tighten all nuts and bolts to their specified torque.
3. Fill the crankcase with recommended grade of oil.
4. Fill the cooling system, then start the engine, and

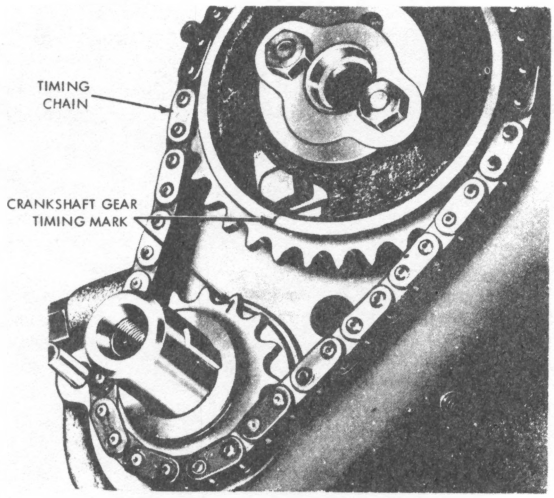


Fig. AA:24 Timing sprocket alignment marks

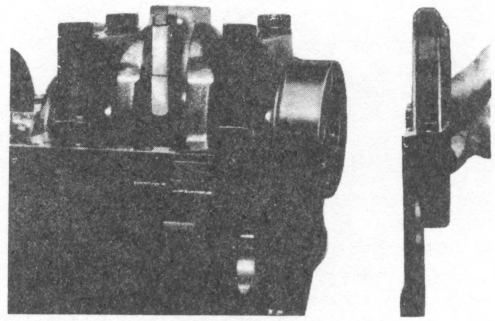


Fig. AA:25 Rear oil seal carrier

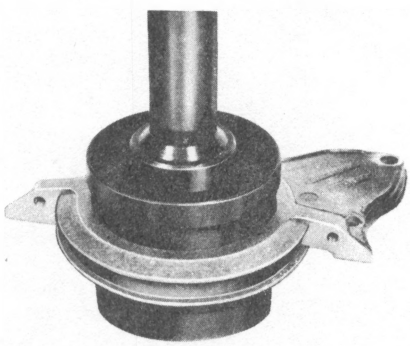


Fig. AA:26 Removing crankshaft oil seal

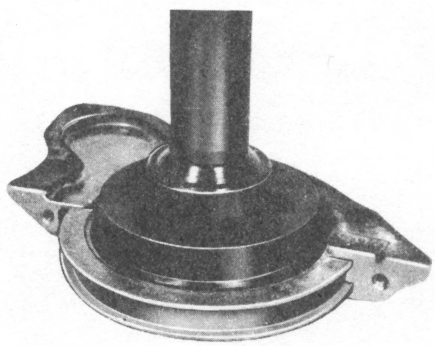


Fig. AA:27 Installing crankshaft rear oil seal

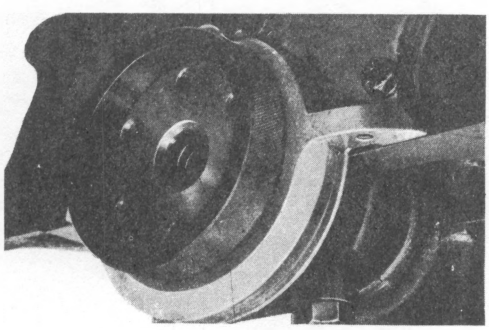


Fig. AA:28 Oil seal carrier alignment tool

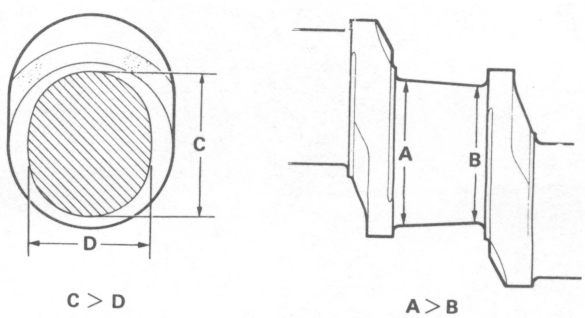


Fig. AA:29 Crankshaft out of round and crankshaft taper

check for oil and water leaks.

5. Check the carburettor idle adjustment and ignition timing, and adjust if necessary.

6. On cars with automatic transmission, check the downshift cable adjustment, as described in the "Automatic Transmission" section.

SUMP

Removal

1. To facilitate access to the two rear sump retaining bolts, the flywheel should first be removed from the engine, otherwise the flywheel must be positioned so that the recesses in its front face are adjacent to each bolt in turn, and the bolts removed using a 3/8 in. square drive socket.

Unscrew the bolts securing the sump to the cylinder block, and detach the sump and gaskets. Remove the cork packing strips from the lower face of the front cover and rear oil seal carrier.

Clean all old gasket material from the cylinder block and sump faces. Clean the inside of the sump, especially under the baffle plate, with petrol or paraffin, and dry thoroughly. Inspect the sump for cracks or holes, a loose baffle, or distortion of the mating face. Inspect the drain plug threads for damage.

It is recommended that the mesh filter screen on the oil pick-up pipe be removed and cleaned prior to installing the sump.

Installation

Position new gaskets on the block flange, using jointing compound at each end. It will help locate the gaskets, if they are smeared with grease before fitting. Apply jointing compound to the cork strips, and fit them to the lower face of the front cover and rear oil seal carrier, with the chamfered ends in the grooves. The ends of the gaskets should be located under the ends of the sealing strips (Fig. AA:21).

Fit the sump, and install the retaining bolts. Tighten the bolts evenly, starting with the four end ones, then working down one side of the sump and up the other. Finally re-tighten in the reverse order to their specified torque. Fit a new sealing ring to the sump drain plug, and tighten the plug to its specified torque. If removed, refit the flywheel as described previously.

TIMING CHAIN

Removal

1. Remove the front cover, following the appropriate steps given previously in "Front Cover Oil Seal".

2. Detach the sump (as above).

3. Remove oil slinger from crankshaft (Fig. AA:22).

4. Unbolt the timing chain tensioner and tensioner arm from the lower face of the cylinder block (Fig. AA:23).

5. Release the locking tab, and unscrew the camshaft sprocket retaining bolts.

6. Detach the sprocket from the camshaft flange, disengage the timing chain from the crankshaft sprocket, and lift out the timing chain and camshaft sprocket.

Installation

Before installing the new timing chain, inspect both timing sprockets for cracks and worn or damaged teeth, and replace as necessary.

1. Lubricate the new chain with engine oil.

2. Turn the crankshaft until the timing mark on the sprocket is pointing towards the camshaft centre.

3. Temporarily fit the camshaft sprocket, and turn the camshaft until the timing mark on the sprocket is adjacent to, and in line with, the crankshaft timing mark (Fig. AA:24).

4. Remove the camshaft sprocket, and fit the timing chain to the sprocket.

5. Locate the chain on the crankshaft sprocket, and refit the camshaft sprocket on the camshaft flange.

6. Fit the retaining bolts and new locking plates to the camshaft sprocket, and check that the timing marks are still correctly aligned.

7. Tighten the camshaft sprocket retaining bolts to their specified torque, and secure by bending up the locking tabs.

8. Locate the chain tensioner arms on the pivot pin at the front main bearing cap (Fig. AA:23). Pre-load the spring of the tensioner, and tighten the assembly securing bolts.

9. Fit the oil thrower ring on the crankshaft, with the dished side facing outwards.

10. Refit the sump and front cover, as described previously.

CRANKSHAFT REAR OIL SEAL

Replacement

Remove the sump, as described above. Remove the flywheel, if not already removed. Remove the bolts securing the rear oil seal carrier to the rear face of the cylinder block, and detach the carrier and oil seal (Fig. AA:25).

Support the carrier around the seal, and drive out the seal from the front, using the Seal Remover Tool shown in Fig. AA:26. Take care to avoid damaging the carrier bore.

Clean the bore in the carrier, and inspect for nicks, etc. Coat the new seal and carrier bore with grease. Locate the seal in the carrier bore, from the front, with the sealing lip facing upwards. With the carrier supported around the seal, drive the seal home, using the Seal Replacer Tool shown in Fig. AA:27.

Slide the carrier with the new seal over the crankshaft, and align in position with the Carrier Centraliser Tool (Fig. AA:28). Tighten the carrier retaining bolts evenly to their specified torque.

If damaged, replace the sump gaskets and cork packing strips, as described previously for sump removal and installation. Otherwise, apply sealing compound to the joints between the cylinder block face and the timing cover and oil seal carrier. Refit the sump, and tighten the bolts, as described previously.

CRANKSHAFT AND BEARINGS

Removal

1. Detach the flywheel from the crankshaft flange.

2. Remove the sump.

3. Detach the crankshaft rear oil seal carrier from the rear face of the cylinder block.

4. Detach the front cover, and remove the timing chain.

5. Unscrew the oil pick-up pipe from the lower face of the cylinder block.

6. Ensure that all bearing caps, both main and connecting rod, are suitably marked so that they can be installed in their original locations.

7. At each connecting rod in turn:-

a) Turn the crankshaft, as necessary, to bring the connecting rod to the bottom of its travel.

b) Remove the two securing bolts, and detach the bearing cap from the connecting rod.

c) Push the piston and connecting rod up the cylinder bore sufficiently to clear the crankshaft.

8. Release the main bearing cap retaining bolts, and detach the main bearing caps.

9. Carefully lift the crankshaft out of the crankcase.

10. Remove the main bearing inserts from the crankcase

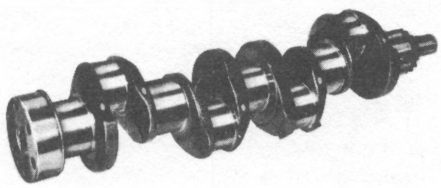


Fig. AA:30 Main bearing journal identification marks

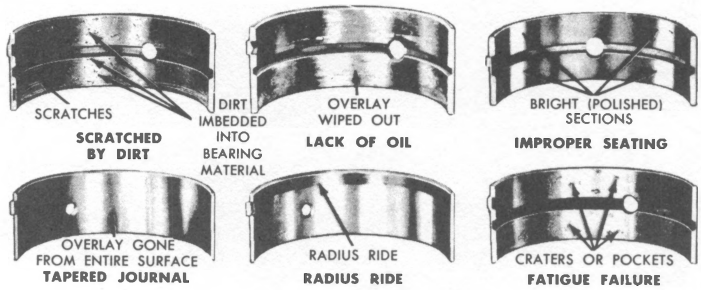


Fig. AA:31 Typical bearing failures

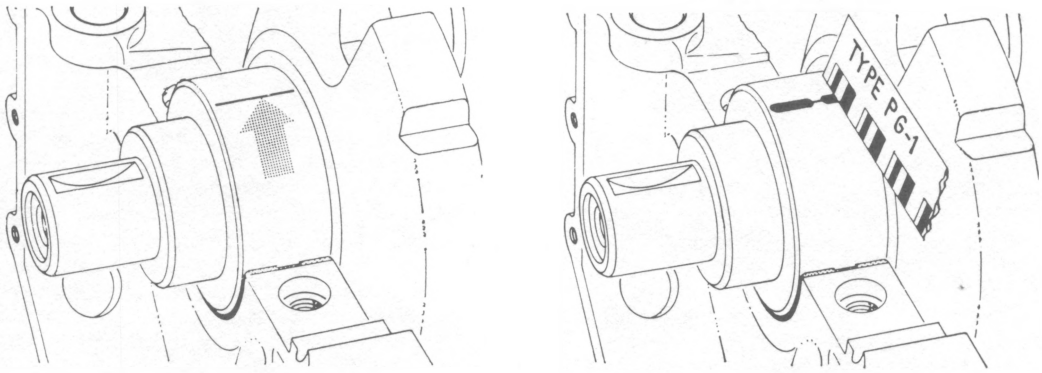


Fig. AA:32 Measuring bearing clearance with Plastigage

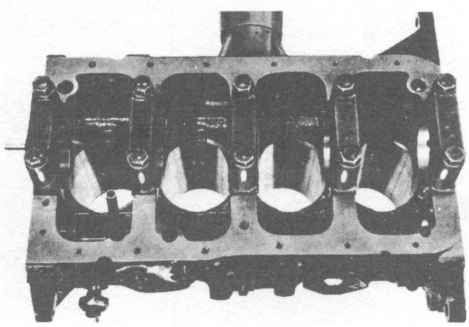


Fig. AA:33 Main bearing parent bore identification marks

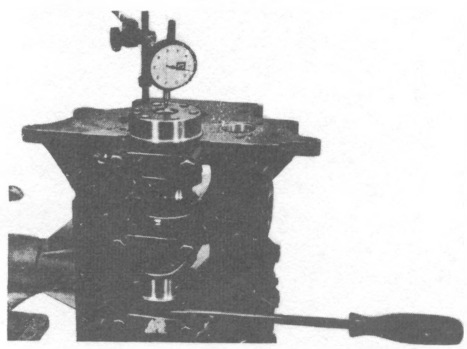


Fig. AA:34 Checking crankshaft end float

and bearing caps. Identify the inserts if they are to be re-used.

11. Remove the bearing inserts from the connecting rods and bearing caps. Identify the inserts if they are to be re-used.

Crankshaft Inspection

1. Wash the crankshaft with petrol or other suitable solvent, and dry thoroughly. Take great care to avoid damaging the machined surfaces. Blow out the oil passages with compressed air. In some cases it may be necessary to probe the passages with a piece of wire to ensure they are clear.

2. Inspect each bearing journal for scratches, scores, grooves or cracks. Inspect the oil sealing surfaces at the crankshaft rear journal for nicks, scratches, sharp edges or burrs which may damage the oil seal or cause premature seal wear. Remove any minor imperfections with an oil stone or emery cloth.

3. Measure the diameter of each journal in at least four places to determine out-of-round (Fig. AA:29), taper and undersize. If the taper or out-of-round exceeds the specified wear limit, or if any of the journal surfaces are severly marked, the crankshaft must be reground or replaced. If any of the journals will not clean up to the maximum undersize bearing available, the crankshaft must be replaced.

The crankshaft main bearing journals may either be of standard diameter or 0,25 mm (0.010 in) undersize, even in new engines. Each of these two grades is sub-divided into two further groups. Each group is identified by respective coloured paint marks (Fig. AA:30).

	Smallest diameter	Largest diameter
Standard	Blue	Red
Undersize	Green	Yellow

The crankshaft big-end journals may either be of standard diameter or 0,25 mm (0.010 in) undersize, even on new engines. Neither of these journal diameters are identified, and the respective diameter can only be determined by measurement.

Clutch Pilot Bearing

On manual transmission models, the clutch pilot bearing is incorporated in the rear end of the crankshaft. The bearing is a press fit in the crankshaft bore, and should not be loose.

Inspect the bearing for roughness, wear, or evidence of overheating. If any of these conditions are found, the bearing must be replaced. Coat the crankshaft bore with a small quantity of wheel bearing grease before installing the new bearing, but do NOT use an excessive amount of grease as it may then by thrown onto the clutch disc in use.

Main & Big End Bearing Inserts

Clean the bearing inserts and caps thoroughly with petrol or other suitable solvent, and dry with compressed air. Do NOT scrape gum or varnish deposits from the inserts. Inspect the bearing surface of each insert carefully. Bearings that are worn, scored, chipped, or pitted should be replaced immediately. Typical examples of unsatisfactory bearings and their causes are shown in Fig. AA:31. The bearing base may be visible, but this does not necessarily mean that the bearing is worn. It is not necessary to fit new bearing inserts in this case, unless the bearing clearance is outside the specified limits. Check the clearance of bearings which appear to be unsatisfactory, as described below.

The main bearing parent bore in the cylinder block may either be of standard diameter or 0,38 mm (0.015 in) oversize. Where an oversize exists, the main bearing caps and crankcase are identified by white paint dots (Fig. AA:33).

The main bearing inserts for standard and 0.25 mm (0.010 in) undersize crankshaft journals are selective fit. The bearing inserts are identified by coloured paint marks in the same way as their respective main bearing journals.

The big-end bearing inserts for standard and 0,25 mm (0.010 in) undersize crankshaft journals are selective fit. However, the bearing inserts are not identified, and in this case, the inserts must be selected by physical measurement of the journals and the parent bore with inserts.

Undersize bearing inserts, which are not selective, are available for use with journals which have been reground undersize.

Checking the Bearing Clearance

NOTE: The procedure for checking the main bearing clearances is given below, but the big-end bearing clearances are checked in a similar manner.

1. Ensure that the crankshaft surface, bearing inserts and bearing caps are perfectly dry and free from oil or dirt.

2. Fit the upper bearing inserts into their locations in the cylinder block. Ensure that the tag on the inserts correctly engages the notch in the housing.

3. Carefully lower the crankshaft into place in the crankcase.

4. Fit the lower insert in the bearing cap of the bearing being measured, again ensuring that the insert is correctly located.

5. Place a piece of Plastigage across the full width of the crankshaft journal, and about 6 mm (0.25 in) off-centre (Fig. AA:32).

6. Install the main bearing cap, and tighten the cap bolts to their normal specified torque.

NOTE: None of the remaining bearing caps must be fitted during this procedure. Each bearing must be measured separately.

7. Release the bolts, and remove the bearing cap.

NOTE: The crankshaft must not be moved while the Plastigage is in position.

8. Measure the width of the Plastigage strip, using the Plastigage scale (Fig. AA:32). The widest point will give the minimum clearance, and the narrowest point the maximum clearance. The difference between the two readings will therefore give the taper on the journal.

9. To check the journal for out-of-round, clean all traces of Plastigage from the journal and insert, rotate the crankshaft 90^{o} and repeat the measuring procedure. The difference between the readings will indicate the out-of-round of the journal.

NOTE: When measurement is completed, all Plastigage material must be cleaned off the bearing insert and crankshaft journal.

When replacing standard or 0,25 mm (0.010 in) undersize bearing inserts with new inserts, select the inserts to give the minimum specified clearance. First check the bearing clearance using two smallest diameter inserts. If the clearance is less than the specified limit, try two largest diameter inserts, or a combination of one large and one small dependent upon the condition. If the specified clearance cannot be obtained with standard or 0,25 mm (0.010 in) undersize bearing inserts, the crankshaft must be reground, and suitable undersize inserts fitted.

Installation

1. Install the selected bearing inserts dry in the cylinder block and main bearing caps. Ensure that the locating tag on the inserts correctly engages the notch in the housings and bearing caps.

2. Install the thrust washers on both sides of the centre main bearing, with the oil groove facing away from the centre bearing.

3. Coat the crankshaft journals and bearing inserts liberally with engine oil.

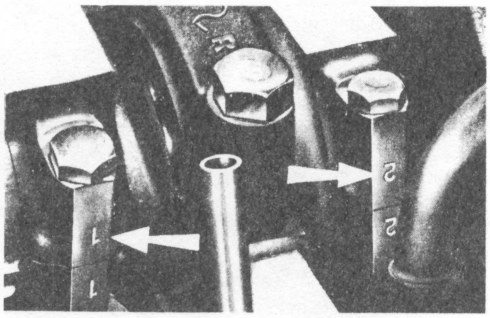


Fig. AA:35 Connecting rod markings

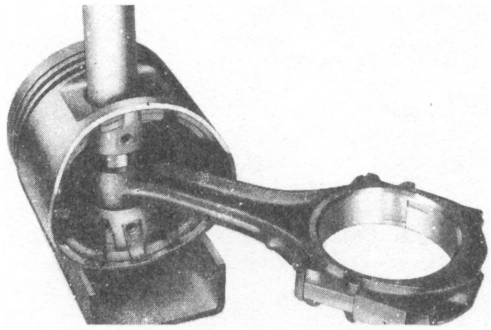


Fig. AA:36 Removing piston pin

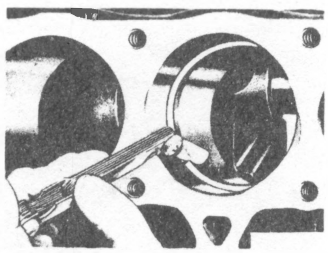


Fig. AA:37 Checking piston ring gap

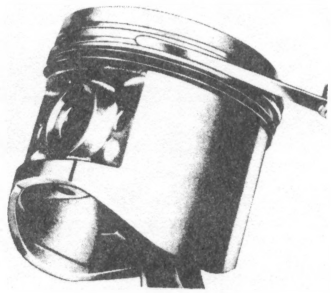


Fig. AA:38 Checking piston ring side clearance

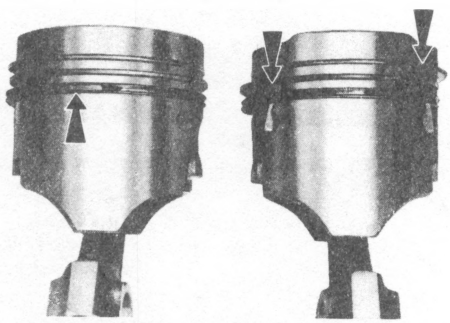


Fig. AA:39 Position of piston ring gaps

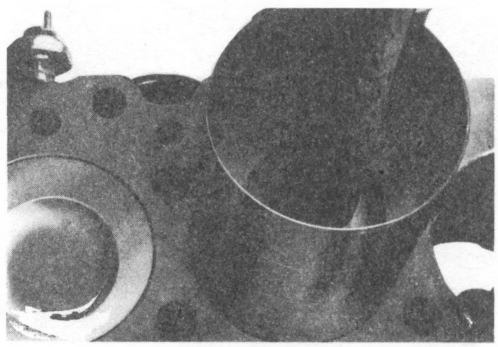


Fig. AA:40 Installing pistons in bores

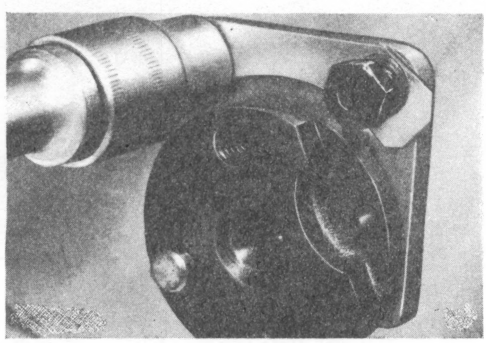


Fig. AA:41 Removing camshaft thrust plate

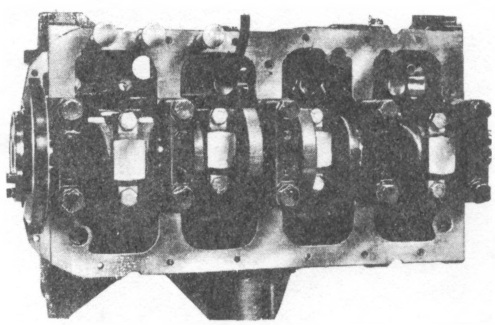


Fig. AA:42 Removing cam followers

4. Carefully position the crankshaft in the cylinder block, and fit the main bearing caps in their respective locations. Tighten the cap bolts to their specified torque.

5. Using a dial indicator gauge located with the stylus against the crankshaft flange, as shown in Fig. AA:34, check the crankshaft end-float. Push the crankshaft fully forwards and zero the indicator. Now force the crankshaft towards the rear of the engine by levering on the crankshaft web with a screwdriver, and note the reading on the indicator. If the end-float exceeds the specified limit, the thrust washers must be replaced with ones of suitable oversize to bring the figure within specification.

6. At each connecting rod in turn:-

a) Install the selected bearing inserts dry in the connecting rod and cap. Ensure that the locating tag on the inserts correctly engages the notch in the bearing bore in the rod and cap.

b) Coat the crankshaft journal and bearing inserts liberally with engine oil.

c) Pull the connecting rod assembly down firmly onto the crankshaft journal, install the cap, and tighten the retaining bolts to their specified torque.

NOTE: The identification numbers on the connecting rod and cap must be on the same side of the assembly (Fig. AA:35).

7. Fit the oil pick-up pipe to the cylinder block lower face. Ensure that the pipe is correctly positioned in relation to the sump.

8. Refit the remainder of the removed components, as described previously under the appropriate headings.

PISTONS AND CONNECTING RODS

Removal

1. Remove the cylinder head.
2. Remove the sump.
3. Unscrew the oil pick-up pipe from the lower face of the cylinder block.
4. Ensure that all the connecting rods and caps are suitably marked with their cylinder numbers, so that they can be installed in their original locations.
5. For each piston and connecting rod in turn:-

a) Turn the crankshaft, as necessary, to bring the connecting rod to the bottom of its travel.

b) Inspect the top of the cylinder bore for any carbon formation or wear ridge. If present, place a cloth on the piston crown to collect removed material and scrape away the carbon deposits, taking great care to avoid damaging the bore. Do not touch the piston travel zone. Remove the cylinder ridge with a ridge cutter, following the instructions of the tool manufacturer.

c) Partially remove the connecting rod cap bolts several turns, and tap them to release the cap. Completely remove the bolts, and detach the bearing cap from the connecting rod.

d) Push the piston and connecting rod up out of the cylinder bore, using the handle end of a hammer. Withdraw the assembly from the top of the cylinder block.

e) Remove the bearing inserts from the cap and rod. Identify the inserts if they are to re-used.

Dismantling

Remove the piston rings from the pistons. Extract the retaining circlips, and push the piston pin out of each piston (Fig. AA:36). Separate the pistons and connecting rods.

Cylinder Bore Inspection

1. Inspect the cylinder walls for scoring, scuffing, roughness or other signs of wear. Check the cylinder bores for out-of-round and taper, using an accurate internal micrometer.

It may be possible to remove minor imperfections by honing, but cylinders which are deeply scored or excessively worn must be rebored to the next oversize. Only cylinders which require it should be rebored, as all pistons both standard and oversize are the same weight, and can therefore be used together without upsetting the engine balance. If a cylinder will not clean up when rebored for the maximum oversize of piston, the cylinder block must be replaced.

NOTE: All the main bearing caps must be in place and tightened to their specified torque during the reboring operation, to avoid distortion of the crankshaft bearing bores.

Where new piston rings are being installed in a used cylinder, the glaze must be removed from the cylinder wall.

After any de-glazing or honing operation, the cylinder bores should be washed with soap or detergent and water, rinsed thoroughly with clean water, then wiped dry with a clean, lint-free cloth. Finally smear the bores with engine oil to prevent corrosion.

In production, the cylinder bores are graded for size, the grade number of each bore being stamped on the push rod side of the cylinder block, adjacent to the top face. Pistons are selected and fitted to correspond to the cylinder bore grading, thus giving the correct working clearance. The piston grade number is marked on the piston crown.

Pistons

1. Remove all deposits from the piston surfaces. Clean any gum or varnish from the piston skirt, piston pin, and rings, with solvent. Do NOT use a caustic cleaning solution or wire brush to clean the pistons. Clean all carbon deposits from the ring grooves, using a suitable ring groove cleaner tool. Ensure that the oil ring holes are clear.

2. Inspect the pistons for fractures at the ring lands, skirts, and pin bosses, and for rough, scored, or scuffed skirts. A shiny surface on the thrust side of the piston, offset from the centre line between the piston pin holes may indicate that the connecting rod is bent. Check the piston ring rooves for high steps at the inner portion of the lower lands, caused by wear. If present, the piston should be discarded. Spongy, eroded areas near the edge of the piston crown are usually caused by detonation or pre-ignition. Replace all pistons which show signs of excessive wear, wavy or stepped ring lands, or fractures or damage from detonation or pre-ignition.

Pistons are available in standard and three oversizes. When selecting replacement standard size pistons, measure each cylinder bore at a point 59,5 mm (2.34 in) from the cylinder block top face across the crankshaft axis to determine the grade of piston required. Select a standard SMALL or standard LARGE piston according to the grade number found for the cylinder bore. If necessary, hone the bore to obtain the correct fit.

When fitting oversize pistons, each cylinder bore must be machined to give the correct fit for the individual piston. To obtain the correct size for the machining of the bore, measure the piston skirt diameter accurately at right-angles to the piston pin at a point 58,74 mm (2.313 in) from the piston crown, and add the specified piston clearance to this figure. Use the maximum piston measurement obtained, as the piston skirt is oval.

Piston Rings

1. Replace all piston rings which are broken, cracked, chipped, scored, or worn. Rings should NOT be transferred from one piston to another, regardless of mileage. It is recommended that new rings be fitted as a matter of course, when over-hauling the engine. Ensure that the proper ring set is selected for the size of piston to be used. When new rings are being installed in a used cylinder bore, the glaze must be removed from the cylin-

der wall.

2. Check the end gap of each piston ring in its respective cylinder, using a feeler gauge (Fig. AA:37). Use an inverted piston to position the ring squarely in the bore. With worn cylinder bores, the ring should be located at the lower limit of travel of the piston rings, as this portion of the bore will be least worn. If the gap is outside the specified limits, try another ring set.

3. Check the side clearance of each compression ring in its respective groove, with a feeler gauge inserted between the ring and the lower land of the groove (Fig. AA:38). The gauge should slide freely around the entire ring circumference without binding.

Piston Pins

1. Inspect the piston pins for signs of wear, etching, or fracture. Check the outside diameter of the piston pin, and the inside diameter of the pin bore in the piston. Replace any piston pin or piston that is not within specification.

The piston pins are selected to give the correct fit in the piston pin bore and small-end bushing in the connecting rod, and should not be interchanged. If an oversize piston pin is being fitted, the pin bores must be reamed to obtain the proper fit. Use only motor-driven reamers, and do not exceed the cutting speed recommended by the reamer manufacturer.

In service, all pistons are supplied complete with the piston pin to ensure the correct fit.

Connecting Rods

1. Check that each connecting rod and cap is marked with its respective cylinder number. If the connecting rods and caps are unmarked, they should be suitably stamped, unless they are being discarded. Remove the bearing inserts from the rod and cap. Identify the inserts if they are to be reused.

2. Clean the rods and caps with petrol or other suitable solvent, and dry thoroughly with compressed air. Blow out the oil passages with compressed air. Inspect the rods for signs of fracture, and the big-end bearing bores for out-of-round and taper. If the bore exceeds the specified limits or if the rod is fractured, it should be replaced.

3. Check the rods for bend or twist, using a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If bend or twist is excessive, the rod must be straightened or replaced.

4. Abnormal wear of the big-end bearings can be caused by either a bent rod, worn or damaged crankpin, or a tapered big-end bearing bore. A shiny surface on the pin boss side of the piston, above the pin on one side and below it on the other, usually indicates that the rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves.

5. Check the inside diameter of the bushing in the connecting rod small-end. Replace the rod if the bore is outside specification. Inspect the condition of the connecting rod nuts and bolts, and replace if defective.

Big-End Bearings

1. Inspect the bearing inserts and crankshaft journals and check the bearing clearances as described previously in "CRANKSHAFT & BEARINGS".

Reassembly

NOTE: The maximum variation in weight between the piston and connecting rod assemblies fitted in an engine is 8 grammes (0.283 oz). When changing pistons or connecting rods in service, the assemblies should be weighted, and if necessary, the parts selected to ensure that the weight variation between the assemblies does not exceed this limit.

For each piston and connecting rod in turn:-

a) Apply a light coat of engine oil to the piston pin and the pin bores in the piston and connecting rod.

b) Assemble the piston to the connecting rod with the "FRONT" marking embossed on the connecting rod web, and the arrow on the piston crown on the same side of the assembly.

c) Heat the piston in water or oil to expand it, then insert the piston pin through the piston and connecting rod, and secure with the two retaining circlips.

d) Fit the piston rings to the piston, the oil control ring first, followed by the lower and then the upper compression rings. The oil control ring may be fitted either way round, but the compression rings must be fitted with the "TOP" marking facing the piston crown.

NOTE: The upper ring, when new, has a reddish-brown running-in compound on the outer edge. On no account must this compound be removed.

Installation

For each piston and connecting rod assembly in turn:

a) Check that the piston is correctly assembled to its respective connecting rod.

b) Position the piston rings with their gaps, as shown in Fig. AA:39. The oil control ring gaps should be to the rear, and the compression ring gaps at 120° to this.

c) Lubricate the cylinder bore liberally with engine oil.

d) Install the assembly in its correct respective bore with the arrow on the piston crown pointing towards the front of the engine.

e) Compress the piston rings, using a piston ring compressor, and push the piston into the cylinder bore with the handle end of a hammer, until it is slightly below the top of the cylinder (Fig. AA:40). Do NOT attempt to fit the pistons by hand, otherwise breakage of the rings may result.

NOTE: Take great care during this operation to avoid the connecting rod hitting and damaging the crankshaft journal.

f) Fit the bearing inserts dry in the connecting rod and cap. Ensure that the locating tag on the inserts correctly engages the notch in the bearing bore in the rod and cap.

g) Coat the crankshaft journal and bearing inserts liberally with engine oil.

h) Pull the connecting rod assembly down firmly onto the crankshaft journal, install the cap, and tighten the retaining bolts to their specified torque.

NOTE: The identification numbers on the connecting rod and cap must be on the same side of the assembly (Fig. AA:35).

2. Fit the oil pick-up pipe to the cylinder block lower face. Ensure that the pipe is correctly positioned in relation to the sump.

3. Refit the remainder of the components, as described previously under the appropriate headings.

CAMSHAFT

Removal

1. Remove the cylinder head, and withdraw the push rods from the cylinder block.

2. Remove the fuel pump, oil pump and distributor from the cylinder block.

3. Remove the front cover, sump and timing chain, as described previously.

4. Unscrew the oil pick-up pipe from the lower face of the cylinder block.

5. Release the lock tabs, and remove the two bolts securing the camshaft thrust plate to the cylinder block front face

(Fig. AA:41). Remove the thrust plate.

6. Carefully withdraw the camshaft from the cylinder block.

NOTE: The cylinder block must be inverted during this operation, otherwise the cam followers will foul the lobes of the camshaft.

7. Extract the cam followers from their bores in the cylinder block, keeping them in their correct order. The crankshaft must be positioned as shown in Fig. AA:42 to allow access to the followers.

8. Installation is a reversal of the removal procedure. Lubricate the camshaft journal and lobes and the cam followers thoroughly, before installing.

Technical Data

Type 'A' Engine (1300 & 1600 OHV)

NOTE: Figures are listed in mm. (in.), except where otherwise stated.

GENERAL

Identification:		
1300	L.C.	J1A
	H.C.	J2A
1600	L.C.	L1A
	H.C.	L2A
Bore		80.98 (3.1882)
Stroke	1300	62.99 (2.4799)
	1600	77.62 (3.0559)
Displacement	1300	1263 cc.
Displacement	1600	1588 cc.
Compression ratio		
1300	L.C.	8.0:1
	H.C.	9.0:1
1600	L.C.	8.0:1
	H.C.	9.0:1
Compression pressure		
at starter speed	1300 L.C.	9 - 11 atu. (128 - 156 psi)
	1300 H.C., 1600 L.C.	10 - 17 atu. (140 - 170 psi)
	1600 H.C.	11 - 13 atu. (156 - 184 psi)
Brake horsepower (DIN-PS at rev/min.)		
	1300 L.C.	54/5,500
	H.C.	57/5,500
	1600 L.C.	65/5,200
	H.C.	68/5,200
Torque (DIN at rev/min.)		
	1300 L.C.	8.7 kgm. (62 lb.ft.)/3,000
	H.C.	9.3 kgm. (67 lb.ft.)/3,000
	1600 L.C.	11.25 kgm. (80.6 lb.ft.)/2,600
	H.C.	11.8 kgm. (84.5 lb.ft.)/2,600
Max. continuous engine speed (rev/min.):		
	1300	5,800
	1600	5,580
Idling speed (rev/min.)		680 - 720
Firing order		1 - 2 - 4 - 3
Cylinder numbering		From front
Initial ignition timing (static)		6^{o} BTDC
Oil pressure (min. at 1,500 rev/min.)		2.5 - 2.8 kg/cm^2 (35 - 40 psi)

CYLINDER BLOCK

Identification	1300	711M-6015-AA
	1600	711M-6015-BA

PISTONS

Piston dia. - tolerance grades for standard Pistons supplied in service:

	1300	1600	
Grade	0	–	80.891 - 80.900 (3.1847 - 3.1850)
	1	0	80.899 - 80.907 (3.1850 - 3.1853)
	2	1	80.907 - 80.914 (3.1853 - 3.1856)

3	2	80.914 - 80.922 (3.1856 - 3.1860)
4	3	80.922 - 80.929 (3.1860 - 3.1862)
5	4	80.929 - 80.937 (3.1862 - 3.1865)
6	5	80.937 - 80.945 (3.1865 - 3.1868)
1300	1600	
7	6	80.945 - 80.952 (3.1868 - 3.1871)
	7	80.952 - 80.960 (3.1871 - 3.1874)

Oversize pistons supplied in service 0.084 (0.0025), 0.38 (0.0015), 0.76 (0.003)
Piston to bore clearance
1300 ..... 0.048 - 0.064 (0.0019 - 0.0025)
1600 ..... 0.041 - 0.056 (0.0016 - 0.0022)

PISTON RINGS

Ring end gap (911) ..... 0.23 - 0.36 (0.0091 - 0.0142)
Ring clearance in piston groove:
compression rings ..... 0.041 - 0.091 (0.0016 - 0.0036)
oil control ring ..... 0.046 - 0.097 (0.0018 - 0.0038)

CONNECTING RODS

Bearing insert inside dia:
standard ..... 49.238 - 49.268 (1.9385 - 1.9397)
Bearing to crankshaft clearance ..... 0.01 - 0.06 (0.0004 - 0.0024)
End-float on crankpin ..... 0.10 - 0.25 (0.004 - 0.010)

CRANKSHAFT

Main bearing journal dia:
standard red ..... 53.993 - 54.003 (2.1257 - 2.1261)
Crankshaft end-float ..... 0.075 - 0.28 (0.003 - 0.01102)
Thrust washer thickness - std. ..... 2.311 - 2.362 (0.091 - 0.093)
Oversize thrust washers available 0.064 (0.0025), 0.127 (0.005), 0.191 (0.0075), 0.254 (0.010)
Crankpin journal dia:
standard ..... 49.195 - 49.215 (1.9368 - 1.9376)

CAMSHAFT

Identification 109E
End-float ..... 0.064 - 0.191 (0.0024 - 0.0079)
Thrust plate thickness ..... 4.46 - 4.51 (0.176 - 0.178)
Valve timing:
Inlet opens ..... 23° BTDC
Inlet closes ..... 53° ABDC
Exhaust opens ..... 53° BBDC
Exhaust closes ..... 23° ATDC

CYLINDER HEAD

Identification 1300 ..... 711F-6090-BA
1600 ..... 711F-6090-CA

FLYWHEEL

Max. permissible run-out 0.08 (0.003)

LUBRICATION SYSTEM

Oil pump inner to outer rotor clearance ..... 0.15 (0.006) max.
outer rotor to housing clearance ..... 0.25 (0.010) max.
rotor end-float ..... 0.13 (0.005) max.
drive shaft to body clearance ..... 0.038 - 0.076 (0.0015 - 0.003)
Oil pressure (min.) at 700 rev/min ..... 0.35 - 0.5 kp/cm^2 (5 - 7 psi)
at 1,500 rev/min ..... 2.45 - 2.8 kp/cm^2 (35 - 40 psi)
Relief valve opens at ..... 2.45 - 2.8 kp/cm^2 (35 - 40 psi)
Oil pressure warning light operates at ..... 0.42 kg/cm^2 (6.0 psi)

Engine 1600/2000 ohc

GENERAL
ENGINE OVERHAUL PROCEDURES
CRANKCASE VENTILATION SYSTEM
OIL FILTER
VALVE CLEARANCES
TOOTHED DRIVE BELT
CAMSHAFT OIL SEAL
CYLINDER HEAD
BALANCE SHAFT OIL SEAL
CRANKSHAFT FRONT OIL SEAL
FLYWHEEL
CRANKSHAFT REAR OIL SEAL
ENGINE - Removal and Installation
SUMP
OIL PUMP
BALANCE SHAFT
CRANKSHAFT AND BEARINGS
PISTONS AND CONNECTING RODS

GENERAL

1600 and 2000 Series models are fitted with a 4 cylinder 'in-line', O.H.C. engine, with toothed belt camshaft drive. This engine is supplied in two capacities: a 1593 cc. version used in 1600 models, and a 1993 cc. version used in 2000 models.

Although of similar basic design, the main components (i.e., block, head, crankshaft, connecting rods, pistons, etc.) differ between the two versions. However, many of the ancilliary components are common. The increased capacity of the larger unit is obtained by lengthening the stroke and increasing the bore diameter.

The cylinder bores are machined directly in the cast-iron cylinder block, and are provided with full-length water jacketing. The cylinders number from the front. The upper-half of the crankcase is integral with the cylinder block, and carries the cast-iron crankshaft in five large diameter main bearings. Crankshaft end-float is controlled by half-thrust washers, located in the cylinder block, on either side of the centre (No. 3) main bearing. The "I" section forged connecting rods have separate big-end caps retained by two bolts. The aluminium alloy pistons are of the flat-top full skirted type with a steel expander strut, and have three pistons rings - two compression, and one oil control-situated above the piston pin bore. The tubular steel piston pin is retained by a press fit in the connecting rod.

The cylinder head, also of cast-iron, is of the cross-flow type with the combustion chambers cast into the lower face. The valves are set at an inclined angle of 15^{O}, and operate in guide bores which are machined directly in the cylinder head. The valves are operated by rocker arms which are individually mounted on adjustable pivot screws. The rocker arms locate on the ends of the valve stems, and are secured to the pivot screws by a spring clip. The rockers are actuated directly by the camshaft which is situated centrally above the arms and is carried in three supports cast integral with the cylinder head. The rocker assembly is enclosed by a pressed-steel rocker cover which incorporates the oil filler. The camshaft is driven at half engine speed, by a single-row internally-toothed belt from a pulley on the crankshaft, via a pulley on an auxiliary shaft, and a tension adjusting idler. The tensioner assembly is mounted on the front face of the cylinder head. The toothed belt is protected by a sheet steel cover.

The auxiliary shaft is situated in the lower L.H. side of the cylinder block, and provides the drive for the fuel pump, ignition distributor, and oil pump. The fuel pump is operated by a short push rod which bears on an eccentric on the shaft, while the distributor is driven by a skew gear. End play of the auxiliary shaft is controlled by a thrust plate at the front end of the shaft. The water pump and alternator are driven by a conventional Vee belt ahead of the camshaft drive. The engine lubrication system is of the pressure feed type, and incorporates a full-flow oil filter (Fig. AB:1). The eccentric bi-rotor type oil pump is mounted inside the crankcase, and is driven from the lower end of the distributor shaft. Oil is drawn into the pump through an oil pick-up pipe mounted on the pump assembly, and fitted with a mesh screen to provide primary filtration. A spring-loaded relief valve in the pump limits the maximum pressure in the system. Oil relieved by the valve is directed back into the inlet side of the pump. All the oil discharged by the pump passes through the full-flow type filter, before it enters the main oil gallery. A by-pass valve is incorporated in the filter to by-pass the filter element if it becomes clogged, thereby maintaining the supply of oil to the engine.

The crankcase ventilation system is of the semi-closed type, and is similar to that described for the Type 'A' engine.

ENGINE OVERHAUL PROCEDURES

Certain engine overhaul operations can only be carried out once the engine has been removed from the car, and these are dealt with in the latter part of this section, after ENGINE - REMOVAL AND INSTALLATION. All other operations can be performed either with the engine still installed, or once it has been removed.

CRANKCASE VENTILATION SYSTEM (Fig. AB:2)

The crankcase ventilation system is similar to that described for the Type 'A' (1300 & 1600 O.H.V.) engine, and should be serviced in a similar manner.

OIL FILTER

The oil filter element is of the throw-away cartridge type, and is screwed onto a threaded adaptor on the L.H. side of the cylinder block. Fig. AB:3. The filter should be renewed each time the engine oil is changed.

1. Remove the sump plug, and allow the engine oil to drain into a suitable container, preferably while the engine is still warm. Wipe the drain plug clean and refit, using a new sealing ring if necessary. Tighten the plug securely.
2. Place a drip pan under the oil filter, and unscrew the canister from its mounting flange on the block. The use of a suitable strap wrench (e.g., Tool No. GV-6883), will facilitate removal of the filter canister if difficult to unscrew. Clean the mounting face of the flange, and coat the sealing ring on the new filter with grease or engine oil. Screw the new filter canister onto the threaded adaptor by hand until the sealing ring just contacts the mounting flange, then further tighten by approx. half a turn.
3. Refill the engine with the recommended grade of oil. Run the engine up to normal operating temperature, then, with the engine at fast idle, check for oil leaks. Recheck the oil level, and top-up as necessary.

VALVE CLEARANCES

NOTE: The valve clearances should be checked and adjusted when

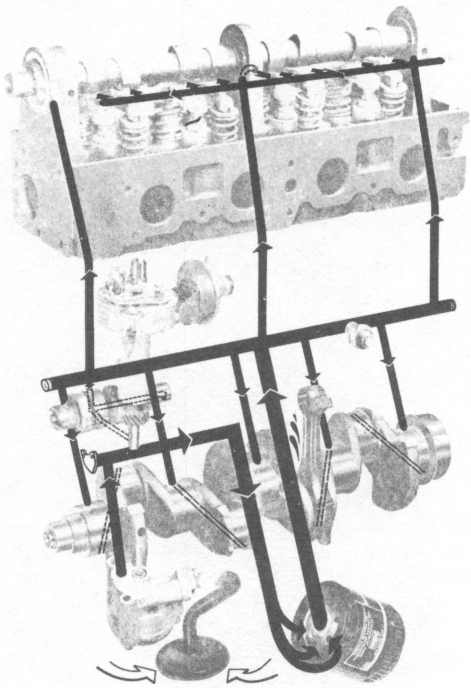


Fig. AB:1 Lubrication system

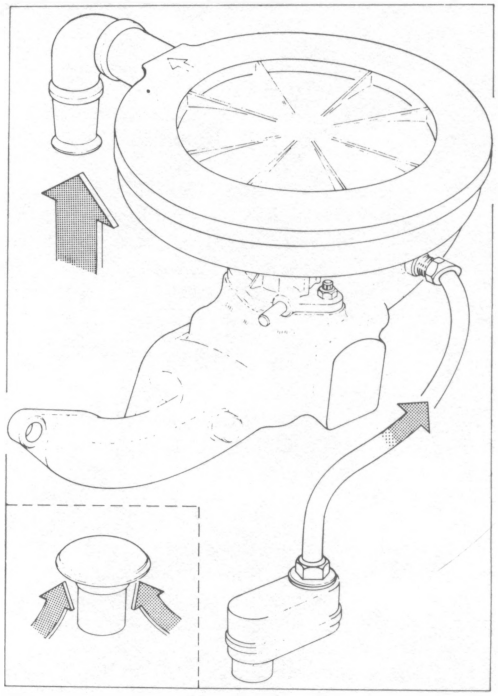


Fig. AB:2 Crankcase ventilation system

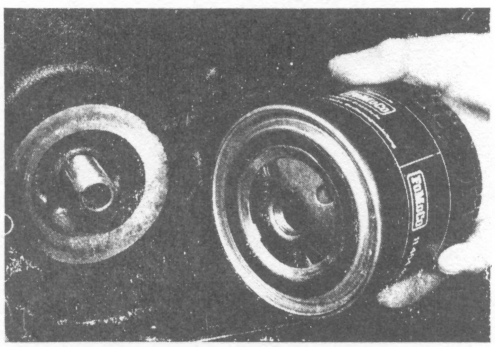


Fig. AB:3 Oil filter replacement

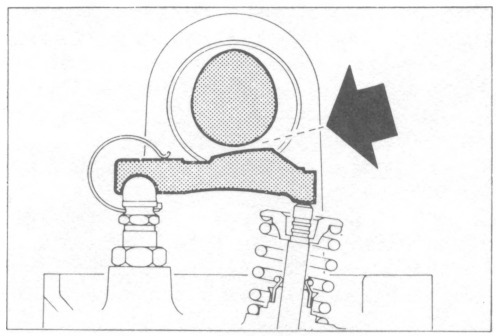


Fig. AB:4 Cam lobe position for measuring valve clearance

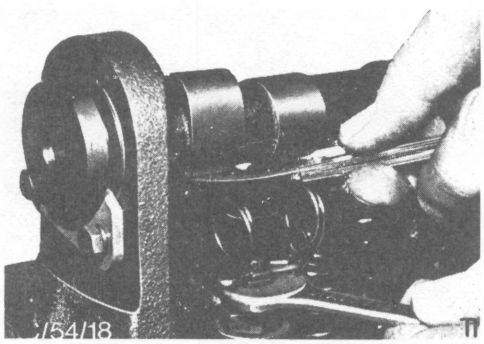


Fig. AB:5 Adjusting valve clearances

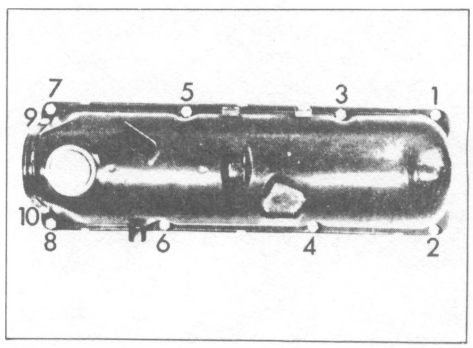


Fig. AB:6 Rocker cover tightening sequence

the engine is hot.

1. Remove the air cleaner from the carburettor.
2. Disconnect the spark plug leads, unclip them from the rocker cover, and place aside.
3. Remove the retaining bolts, and detach the rocker cover and gasket. Discard the gasket.
4. Remove the spark plugs, to allow easy rotation of the engine.
5. Rotate the crankshaft until the toe of each cam lobe in turn is positioned upwards, then check the clearance between the rocker arm and the cam (Fig. AB:5).

If required, the clearances can be checked, two at a time, by positioning the cam lobes for each respective valve pair upwards, so as to form a 'V' configuration, then measuring the clearance for both valves. In either case, the clearance should be:

Inlet	0,20 mm (0.008 in)
Exhaust	0,25 mm (0.010 in)

The setting is correct when the appropriate thickness of feeler blade is a neat sliding fit between the rocker arm and the cam lobe.

NOTE: The valve arrangement, from the front is Ex-In-Ex-In-Ex-In-Ex-In.

6. If adjustment is necessary, slacken the locknut, and rotate the ball-headed adjusting nut at the rocker arm pivot, until the correct gap is obtained. Tighten the locknut, and recheck the clearance.
7. When adjustment is completed, refit the rocker cover, using a new gasket. Ensure that the dove-tail of the gasket is correctly seated in its recess. Tighten the rocker cover bolts in the sequence shown in Fig. AB:6.
8. Install the spark plugs, and reconnect the H.T. leads.
9. Refit the air cleaner.

TOOTHED DRIVE BELT

Replacement

1. Disconnect the battery.
2. Slacken the alternator adjusting and mounting bolts, swing the alternator towards the engine, and detach the Vee belt from the pulleys.
3. Remove the three retaining bolts, and detach the toothed belt guard from the front of the engine (Fig. AB:7).
4. Turn the engine to the TDC position. The point on the camshaft pulley belt guide plate should be aligned with the timing mark on the cylinder head (Fig. AB:9). Remove the distributor cap, and check that the rotor arm is pointing towards the No. 1 HT contact in the cap.
5. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt.
6. Disengage the toothed belt from the camshaft, auxiliary shaft, and crankshaft pulleys, and remove the belt.
7. Check that the camshaft pulley and distributor rotor arm are positioned, as described above, then fit the toothed belt.

NOTE: If the crankshaft has been moved during this operation, it will be necessary to remove the Vee belt pulley from the crankshaft, to determine that the crankshaft key is orientated towards the camshaft pulley, as shown in Fig. AB:9.

8. Release the tension roller adjusting bolt (Fig. AB:11.1) turn the engine twice, then tighten the adjusting bolt. This will automatically load the belt to the correct tension.
9. Refit the belt guard.
10. Refit the Vee belt and adjust the tension as described in the COOLING SYSTEM Section.
11. Reconnect the battery.

CAMSHAFT OIL SEAL

Replacement

1. Disconnect the battery and drain the cooling system.
2. Disconnect the radiator hoses, and remove the radiator (see COOLING SYSTEM).
3. Detach the water outlet housing, complete with thermostat from the front face of the cylinder head.
4. Remove the three retaining bolts and detach the toothed drive belt guard from the front of the engine.
5. Turn the engine to the TDC position. The pointer on the camshaft pulley guide plate should be aligned with the timing mark on the cylinder head (Fig. AB:9). Remove the distributor cap, and check that the rotor arm is pointing towards the No. 1 HT contact in the cap.
6. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt.
7. Disengage the toothed belt from the camshaft pulley.

NOTE: Do NOT move the crankshaft or auxiliary shaft while the toothed belt is removed.

8. Remove the centre-bolt and detach the pulley and belt guide plate from the camshaft.
9. Extract the oil seal from the front of the cylinder head, using Oil Seal Remover, Service Tool No. 21.008 (Fig. AB:8).
10. Lubricate the new oil seal lightly with oil, place it on the Oil Seal Replacer, Service Tool No. 21.009, then force it into position in the cylinder head (Fig. AB:10).
11. Refit the camshaft pulley and belt guide plate, and tighten the centre-bolt to its specified torque.
12. Ensure that the pointer on the camshaft pulley belt guide plate is aligned with the timing mark on the cylinder head, then refit the toothed belt on the pulley.

NOTE: If the crankshaft or auxiliary shaft have been moved, they must be repositioned, as previously above in "TOOTHED DRIVE BELT-Replacement'.

13. Release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt.
14. Refit the drive belt guard.
15. Refit the water outlet housing on the cylinder head, using a new gasket coated with sealer.
16. Install the radiator, and reconnect the hoses.
17. Refill the cooling system, and reconnect the battery.

CYLINDER HEAD

Removal

1. Disconnect the battery.
2. Remove the bonnet.
3. Remove the air cleaner.
4. Drain the cooling system (see COOLING SYSTEM).
5. Disconnect the radiator top hose at the cylinder head water outlet housing.
6. Disconnect the lead from the temperature sender unit.
7. Disconnect the accelerator cable at the throttle control shaft and mounting bracket (see FUEL SYSTEM).
8. Disconnect the fuel supply pipe, distributor vacuum line and automatic choke hoses at the carburettor.
9. Disconnect the water and vacuum hoses, at the inlet manifold.
10. Disconnect the H.T. leads at the spark plugs, unclip the leads from the rocker cover, and place aside.
11. Disconnect the exhaust down-pipe from the exhaust manifold outlet.

Fig. AB: 7 Belt guard retaining bolts

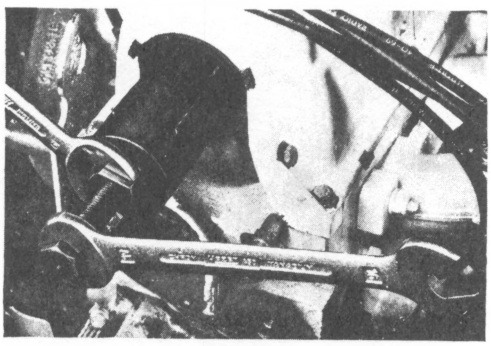


Fig. AB:8 Removing camshaft oil seal

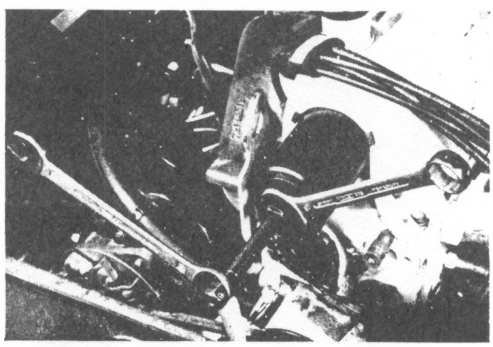


Fig. AB:10 Installing camshaft oil seal

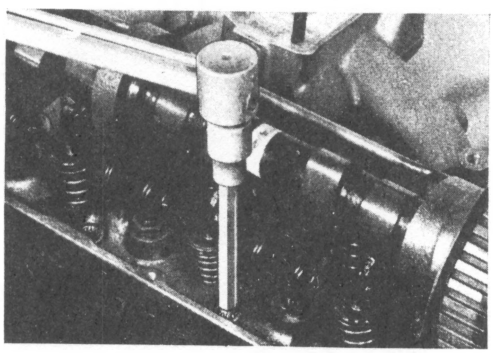


Fig. AB:12 Removing cylinder head bolts

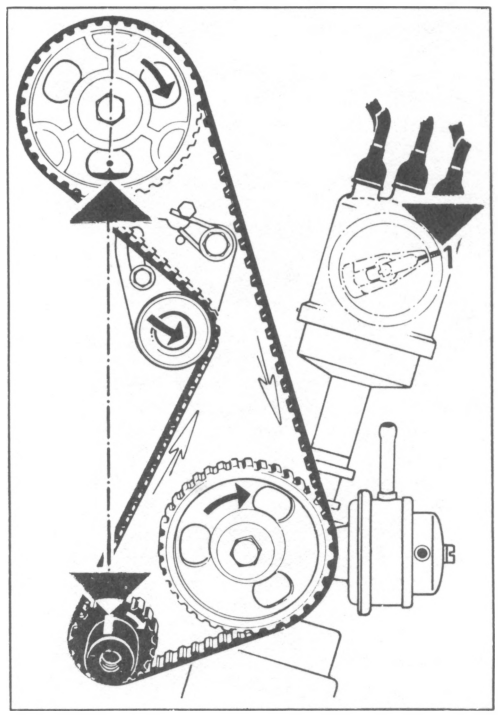


Fig. AB:9 Timing gear alignment marks

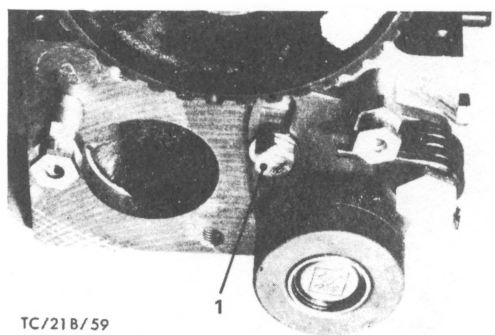


Fig. AB:11 Belt tension roller

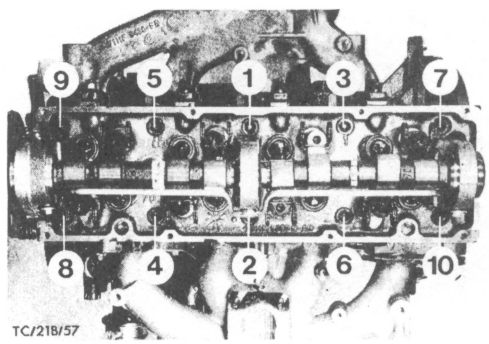


Fig. AB:13 Cylinder head tightening sequence

12. Detach the belt guard from the front of the engine. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt. Disengage the toothed drive belt from the camshaft pulley.

13. Remove the rocker cover and gasket, and discard the gasket.

14. With the aid of the Cylinder Head Bolt Wrench, Service Tool No. 21.002, release the cylinder head bolts evenly (Fig. AB:12) in the reverse order to that shown in Fig. AB:13. Lift off the cylinder head and gasket. Discard the gasket.

Installation

Installation is a reversal of the removal procedure, with attention to the following points:-

a) Ensure that all mating surfaces, especially those of the cylinder head and block, are perfectly clean and free from old gasket material.

b) If the cylinder head was removed to change the cylinder head gasket, check the flatness of the cylinder head and block before reassembly.

c) Use new gaskets where appropriate.

d) The use of two guide studs, made up and screwed into the cylinder head bolt holes, as shown in Fig. AB:14, will facilitate correct alignment of the cylinder head and gasket during installation. Once the head is installed, the studs are then replaced by the cylinder head bolts.

e) Do not use sealing compound of any type on the cylinder head gasket.

f) Use Cylinder Head Bolt Wrench, Service Tool No. 21. 21.002 to tighten the cylinder head bolts. Tighten the bolts evenly to their specified torque, in the sequence shown in Fig. AB: 13.

g) Before fitting the toothed drive belt on the camshaft pulley, ensure that the engine is in the TDC position. Remove the distributor cap, and check that the rotor arm is pointing towards the No. 1 HT contact in the cap. Turn the camshaft until the pointer on the camshaft pulley belt guide plate is aligned with the timing mark on the cylinder head (Fig. AB:9).

h) To correctly tension the toothed drive belt, release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt. (Fig. AB:11.1).

i) Ensure that the dove-tail on the rocker cover gasket is correctly seated in its recess. Tighten the rocker cover bolts in the sequence shown in Fig. AB:7.

j) When installation is completed fill the cooling system, then start the engine and check for oil, water or exhaust leaks.

Dismantling

1. Remove the spark plugs.
2. Remove the exhaust manifold.
3. Remove the inlet manifold complete with carburettor.
4. Detach the water outlet housing, complete with thermostat, from the front face of the cylinder head.
5. Detach the rocker gear oil feed pipe from the camshaft supports.
6. Remove all deposits of carbon from the combustion chambers and valve heads, with a suitable scraper and wire brush. Take care not to scratch the cylinder head machined face.
7. At each valve in turn:-

a) Remove the spring clip securing the rocker arm to the ball-headed pivot screw.

b) Compress the valve spring, using Spring Compressor, Service Tool No. 21.005, and remove the rocker arm (Fig. AB: 15.1).

c) Using Valve Holder, Service Tool No. 21.006 (Fig. AB: 15.2) inserted in the spark plug hole to retain the valve head in position, compress the valve spring, again with the Spring Compressor Tool.

d) Extract the two split tapered collets from around the valve stem (Fig. AB:16).

e) Release the compressor, and remove the spring retainer and valve spring.

f) Using a screwdriver, prise the valve stem oil seal out of its seat (Fig. AB:17).

Discard the seal.

g) Remove the Valve Holder Tool, and withdraw the valve.

h) Unscrew the ball-headed pivot screw from the cylinder head.

i) Identify all the components of the valve assembly.

8. Remove the centre-bolt, and detach the belt pulley and guide plate from the camshaft.
9. Extract the camshaft oil seal from the front of the cylinder head, using Oil Seal Remover Service Tool No. 21.008.
10. Remove the camshaft thrust plate from the rear face of the cylinder head, and withdraw the camshaft to the rear.

Inspection and Overhaul

The inspection and overhaul procedures for the components of the cylinder head are similar to those already described for the Type 'A' engine. Any points of difference or special note are given below:-

Valve Seats

When narrowing the valve seats, the following sizes of cutters should be used:-

Valve seat angle	Top face cutter	Bottom face cutter
44° 30'-50°	35°	65°

Valve seat inserts are not available for this engine.

Rocker Assembly

Inspect the rocker arms for indications of scuffing or abnormal wear on their contact surfaces. If grooved or worn, replace the arm. Do NOT attempt to true by grinding.

Inspect the ball-headed pivot screws for signs of wear or damaged threads. Replace damaged screws or locknuts. Inspect the retaining clips for wear or damage, and replace as necessary.

Camshaft

Clean the camshaft with petrol or other suitable solvent, and wipe dry. Inspect the cam lobes and journals for signs of abnormal wear. Lobe wear characteristics may result in slight pitting in the general area of the lobe toe, but this is not detrimental to the operation of the camshaft and the camshaft need not be replaced unless the lobe lift loss is excessive.

Reassembly

1. Pass the camshaft into the supports on the cylinder head from the rear.
2. Fit the thrust plate to the rear of the camshaft, and secure with the two bolts.
3. Check the camshaft end-float, by measuring the clearance of the thrust plate in the camshaft locating groove. If the end-float exceeds the specified limits, renew the thrust plate. Two thicknesses of thrust plate are available.
4. Lubricate a new camshaft oil seal lightly with oil. Place the seal on the Oil Seal Replacer, Service Tool No. 21.009, then

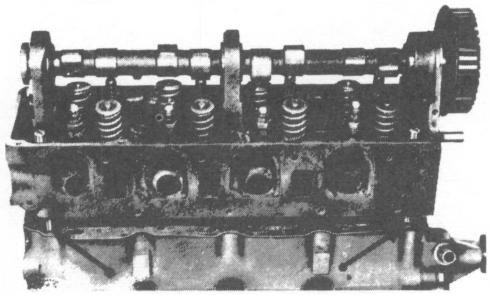


Fig. AB:14 Installation guide pins

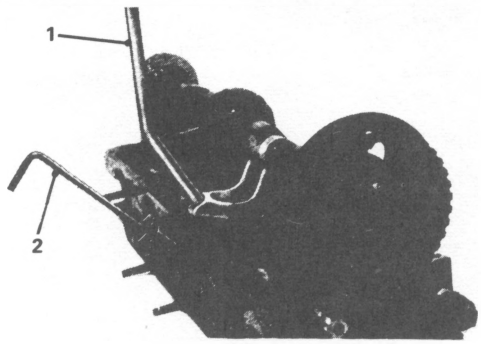


Fig. AB:15 Removing rocker arms with service tool

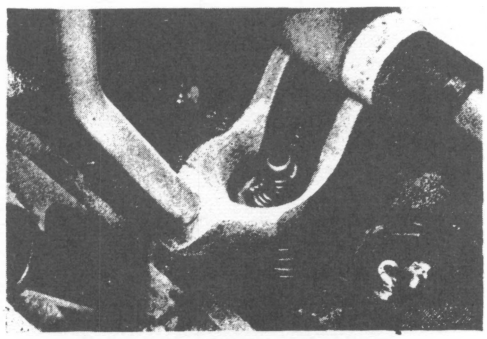


Fig. AB:16 Valve spring collets

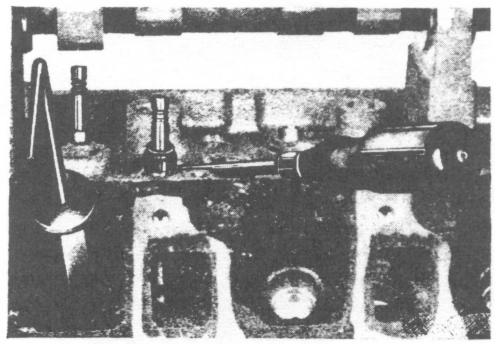


Fig. AB:17 Removing valve stem oil seals

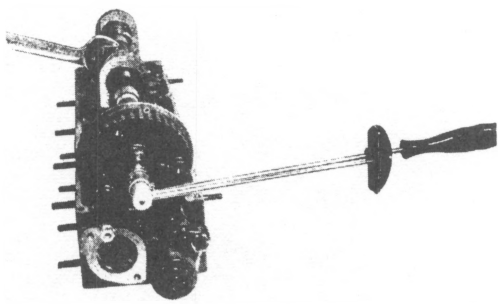


Fig. AB:18 Tightening camshaft sprocket retaining bolt

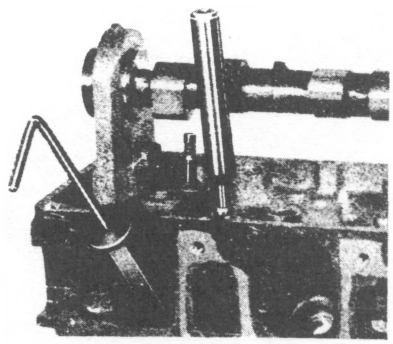


Fig. AB:19 Installing valve stem oil seals

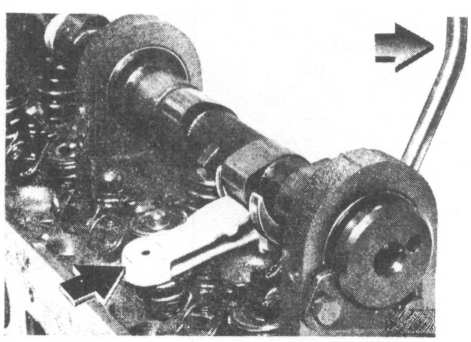


Fig. AB:20 Installing rocker arms

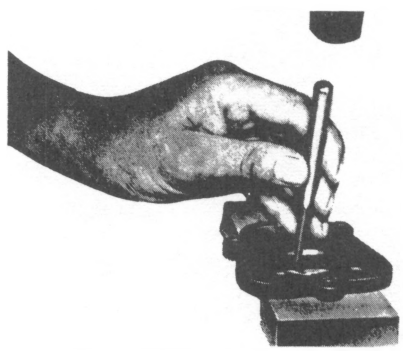


Fig. AB:21 Removing balance shaft oil seal

force it into position in the cylinder head.

5. Fit the belt guide plate and pulley on the camshaft and secure with the centre-bolt (Fig. AB:18).

6. For each valve in turn:-

a) Oil the valve stem, and insert the valve into its respective guide.

b) Fit a new oil seal over the valve stem, and force it into position, using Stem Oil Seal Replacer, Service Tool No. 21.007 (Fig. AB:19).

c) Fit the rocker arm pivot screw to the cylinder head.

d) Retain the valve in position with the Valve Holder Tool, and position the valve spring and retainer over the valve stem.

e) Compress the spring with the Spring Compressor Tool and install the two split tapered collets (Fig. AB:16).

f) Slowly release the compressor to engage the collets in the retainer taper and valve stem grooves. Remove the Valve Holder Tool.

g) Again compress the valve spring, and engage the rocker arm on the pivot screw and valve stem (Fig. AB:20).

h) Remove the Spring Compressor, and secure the rocker arm on the pivot screw with the spring clip.

7. Refit the rocker gear oil feed pipe.

8. Refit the water outlet housing, using a new gasket coated with sealer.

9. The manifolds can be fitted to the cylinder head either before or after installation.

Ensure that the mating faces on the cylinder head and both manifolds are clean and free from old gasket material. Apply jointing compound to both sides of the new inlet manifold gasket around the water jacket port, then assemble the inlet manifold, complete with carburettor, to the cylinder head. Fit the exhaust manifold, using a new gasket. Tighten the retaining nuts and bolts on both manifolds to their specified torques.

10. Fit the spark plugs, and tighten to their specified torque.

BALANCE SHAFT OIL SEAL

Replacement

1. Disconnect the battery.

2. Remove the three retaining bolts, and detach the toothed belt guard from the front of the engine (Fig. AB:7).

3. Turn the engine to the TDC position. The pointer on the camshaft pulley belt guide plate should be aligned with the timing mark on the cylinder head (Fig. AB:9). Remove the distributor cap, and check that the rotor arm is pointing towards the No. 1 HT contact in the cap.

4. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt.

5. Disengage the toothed belt from the balance shaft pulley.

NOTE: Do not move the crankshaft while the toothed belt is removed.

6. Remove the centre-bolt, and detach the pulley from the balance shaft.

7. Remove the three bolts securing the balance shaft cover plate to the cylinder block front face, and detach the cover with the oil seal.

8. Drive the oil seal out of the cover, using a suitable punch (Fig. AB:21). Take care to avoid damaging the cover bore.

9. Lubricate the new oil seal lightly with oil, and force it into position in the cover plate.

10. Clean all old gasket material from the mating faces of the cover plate and cylinder block.

11. Fit the cover plate, using a new gasket. Cut off surplus gasket which is not required. Tighten the cover retaining bolts to their specified torque.

12. Refit the balance shaft pulley, and tighten the centre-bolt to its specified torque.

13. Ensure that the crankshaft, camshaft and balance shaft are in their correct positions, as described previously in Item 3, then fit the toothed belt on the pulley.

14. Release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt.

15. Refit the drive belt guard.

16. Reconnect the battery.

CRANKSHAFT FRONT OIL SEAL

Replacement

1. Disconnect the battery, and drain the cooling system.

2. Disconnect the radiator hose, and remove the radiator (see COOLING SYSTEM).

3. Slacken the alternator adjusting and mounting bolts, swing the alternator towards the engine, and detach the Vee belt from the pulleys.

4. Remove the three retaining bolts, and detach the toothed drive belt guard from the front of the engine.

5. Turn the engine to the TDC position. The pointer on the camshaft pulley belt guide plate should be aligned with the timing mark on the cylinder head (Fig. AB:9). Remove the distributor cap, and check that the rotor arm is pointing towards the No. 1 HT contact in the cap.

6. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt.

7. Disengage the toothed belt from the crankshaft pulley.

8. Remove the centre-bolt and washer from the crankshaft, and withdraw the Vee belt drive pulley.

9. Detach the thrust plate and toothed belt pulley from the crankshaft.

10. Extract the crankshaft front oil seal from the front cover, using Oil Seal Remover, Service Tool, No. 21.008.

11. Lubricate the new oil seal lightly with oil, slide it onto the Oil Seal Replacer, Service Tool NO. 21.009 then force it into position in the front cover (Fig. AB:22).

12. Slide the toothed pulley, thrust plate and Vee belt pulley onto the crankshaft, and secure with the centre bolt and large washer.

The thrust plate is dished, and must be fitted with the convex side towards the toothed pulley (Fig. AB:23).

13. Ensure that the crankshaft, camshaft and balance shaft are in their correct positions, as described above in Item 5, then fit the toothed belt on the pulley.

14. Release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt.

15. Refit the drive belt guard.

16. Refit the Vee belt and adjust the tension, as described in the COOLING SYSTEM Section.

17. Install the radiator and reconnect the hoses.

18. Refill the cooling system, and reconnect the battery.

FLYWHEEL

Remove inspect and install the flywheel, in the same manner as described for the Type 'A' engine.

CRANKSHAFT REAR OIL SEAL

Replacement

The crankshaft rear oil seal can be replaced, after removing the flywheel. Extract the oil seal from the rear main bearing,

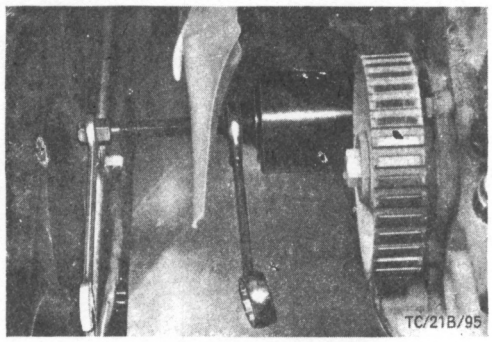


Fig. AB:22 Installing crankshaft front oil seal

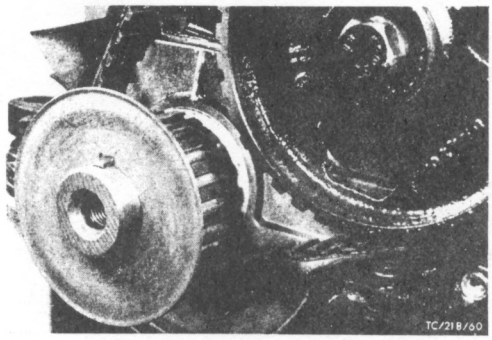


Fig. AB:23 Crankshaft sprocket thrust plate installation

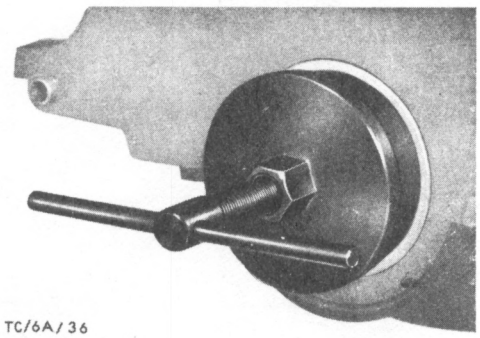


Fig. AB:24 Removing crankshaft rear oil seal

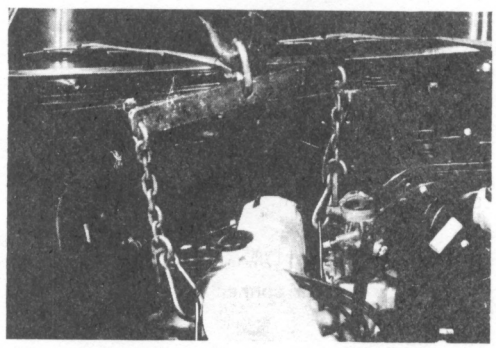


Fig. AB:25 Engine removal

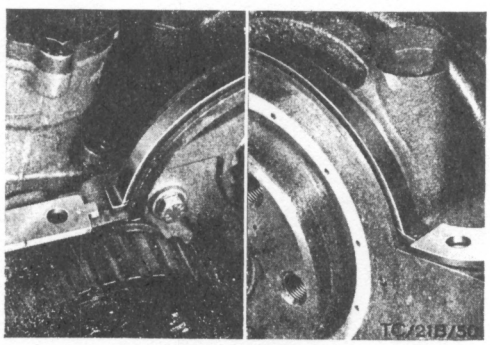


Fig. AB:26 Sump gasket installation

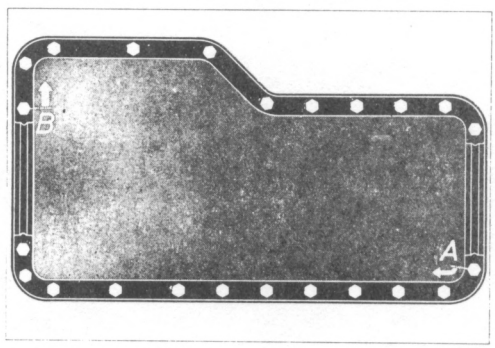


Fig. AB:27 Sump bolt tightening sequence

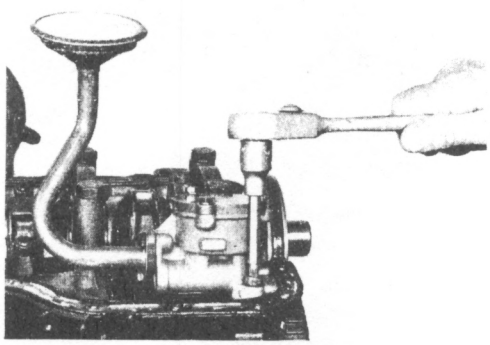


Fig. AB:28 Removing oil pump retaining bolts

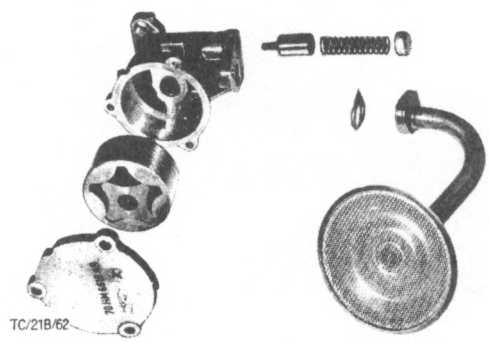


Fig. AB:29 Oil pump assembly

using Rear Oil Seal Remover, Service Tool No. 21.010 (Fig. AB: 24).

Lubricate the sealing lips of the new oil seal with engine oil. Slide the seal onto the Rear Oil Seal Replacer, Service Tool No. 21.011, then drive it into its seat until it rests against the abutment.

ENGINE - Removal

1. Disconnect the battery and engine negative earth strap.
2. Drain the crankcase and cooling system.
3. Remove the bonnet.
4. Remove the air cleaner.
5. Disconnect the radiator hoses at the engine. Remove the radiator and shroud (where fitted) (see COOLING SYSTEM).
6. Remove the lower starter motor bolts and LH side bracket.
7. Disconnect the exhaust pipe at the exhaust manifold.
8. Remove the nuts from both front engine mountings.
9. Disconnect the following:-

a) Water hoses at carburettor and water pump.
b) Alternator leads at alternator.
c) Starter cable at starter motor.
d) Accelerator cable at throttle control shaft and mounting bracket.
e) Down-shift cable at throttle control shaft and mounting bracket (Auto-Trans only).
f) Fuel tank line at fuel pump inlet. Plug tank line.
g) L.T. lead at ignition coil.
h) Oil pressure and water temperature sender unit leads at sender units.

10. Remove the starter motor.
11. On manual gearbox models, disconnect the clutch control cable from the release arm and abutment bracket.
12. On auto. transmission models, remove the torque converter to drive plate retaining bolts.
13. Support the clutch/converter housing with a jack.
14. Remove the clutch/converter housing to engine retaining bolts.
15. On auto. transmission models, remove the torque converter to drive plate retaining bolts.
16. Support the clutch/converter housing with a jack.
17. Attach a suitable lifting fixture or sling to the engine.
18. Raise the engine slightly to disengage it from the transmission, then carefully lift out of the engine compartment (Fig. AB:25).

Installation

Installation is a reversal of the removal procedure, with attention to the following points:-

a) On cars with manual transmission, it may be necessary to turn the engine over slowly to allow the splines on the gearbox input shaft to mesh with the clutch disc hub.
b) Tighten all nuts and bolts to their specified torques.
c) Fill the crankcase with the recommended grade of oil.
d) Fill the cooling system, and then start the engine and check for oil, water, and exhaust leaks.
e) Check the carburettor idle adjustment and ignition timing, and adjust if necessary.
f) On cars with automatic transmission check the downshift cable adjustment, as described in the AUTOMATIC TRANSMISSION Section.

SUMP - Removal

Unscrew the bolts securing the sump to the cylinder block and detach the sump and gaskets. Remove the rubber packing strips from the lower face of the front cover and rear main bearing cap.

Clean all old gasket material from the cylinder block and sump faces. Clean the inside of the sump with petrol or paraffin, and dry thoroughly. Inspect the sump for crack, holes, or distortion of the mating face. Inspect the drain plug threads for damage.

It is recommended that the mesh filter screen on the oil pick-up pipe be removed and cleaned, prior to refitting the sump.

Installation

Fit new rubber packing strips in the lower face of the front cover and rear main bearing. Coat the cylinder block to front cover joints with sealing compound.

Position new cork gaskets on the block flange. It will help locate the gaskets if they are smeared with grease before fitting. Tuck the locating lugs on the ends of the cork gaskets under the recesses in the rubber packing strips (Fig. AB:26).

Fit the sump and install the retaining bolts. Tighten the bolts evenly, to their specified torque, following the sequence shown in Fig. AB:27. Fit a new sealing ring to the sump drain plug, and tighten the plug securely.

OIL PUMP

Removal

Remove the sump, as described above.

With the aid of Oil Pump Wrench, Service Tool No. 21.012, unscrew the oil pump retaining bolts (Fig. AB:28). Detach the pump, complete with the oil pick-up pipe, from the crankcase.

Installation

Fit the oil pump, ensuring that the locating bush is positioned in the block. Tighten the pump retaining bolts to their specified torque, using the Oil Pump Wrench. Install the sump, as described previously.

Dismantling

The inner and outer rotors are a matched pair, and if being re-used, must be installed in their original positions. Before removing the rotors, they should be suitably marked on their outer face, to ensure correct reassembly. In service, the rotors are supplied only as a matched pair, and new rotors must only be used as assembled in their original packing.

Remove the two retaining bolts, and detach the oil pick-up pipe and gasket from the pump body. Unbolt the cover plate, and withdraw both rotors from the housing.

If required, the oil pressure relief valve spring and plunger can be removed from the pump body after extracting the valve sealing plug. To remove the plug, punch a hole in the centre, and screw in a self-tapping screw of appropriate diameter (Fig. AB:30). The plug can then be levered out of the relief valve bore, and the spring and plunger removed.

Inspection

Wash all parts in suitable solvent, and dry thoroughly with compressed air. Use a brush to clean the inside of the pump housing and the pressure relief valve bore. Ensure that all metal particles and dirt are removed.

Inspect the inside face of the pump cover for scores, grooves, or other signs of wear. If present, the cover must be replaced. Inspect the inside of the pump housing and the rotors for damage or signs of excessive wear.

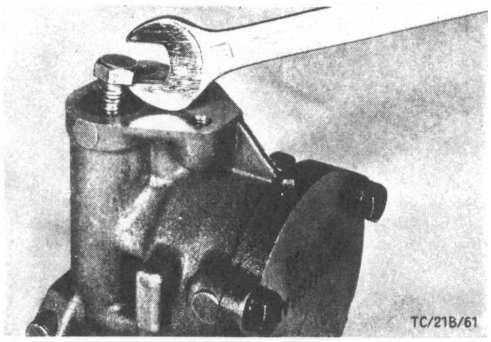


Fig. AB:30 Removing relief valve sealing plug

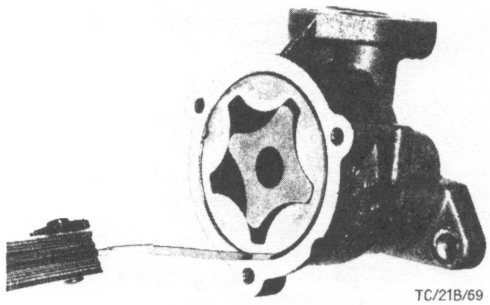


Fig. AB:31 Measuring pump outer lobe to housing clearance

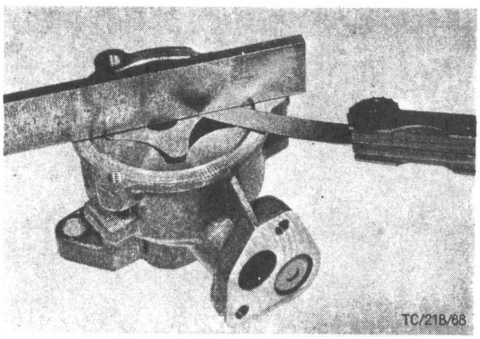


Fig. AB:32 Measuring rotor end clearance

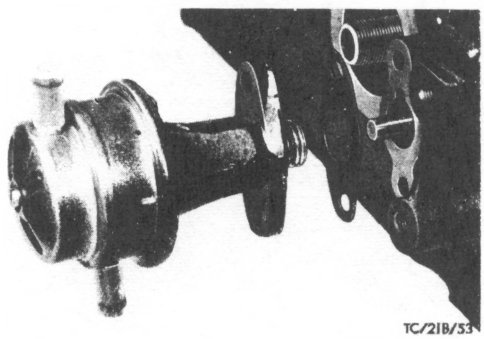


Fig. AB:33 Fuel pump installation

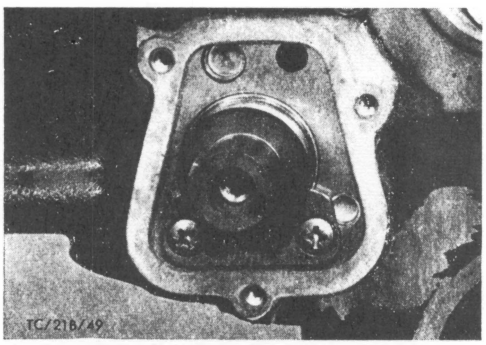


Fig. AB:34 Auxilliary shaft installation

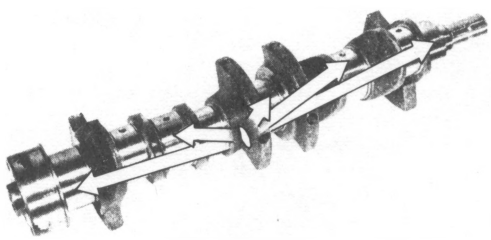


Fig. AB:35 Identification for main bearing journals of the same diameter

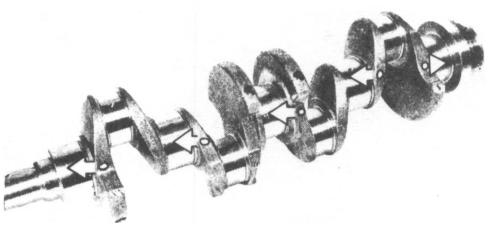


Fig. AB:36 Identification for main bearing journals of varying tolerance

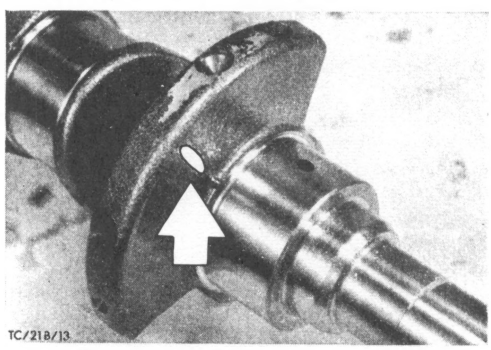


Fig. AB:37 Identification for undersize main bearing journals

Install the rotors, correctly orientated, in the pump housing. Check the clearance between the outer rotor and the pump housing, with a feeler blade (Fig. AB:31). If the clearance exceeds 0,30 mm (0.012 in) the rotor assembly and/or pump body should be replaced.

Check the clearance between the lobes of the inner and outer rotors. If the clearance exceeds 0,20 mm (0.008 in) both rotors must be replaced.

Check the rotor end-float by placing a straight-edge across the face of the pump body, and measuring the clearance between the straight-edge and the rotors (Fig. AB:32). The clearance should not exceed 0,10 mm (0.004 in). If the end-float is excessive, the pump housing should be replaced. Alternatively, the pump face can be carefully lapped on a flat surface.

Inspect the relief valve spring for wear, damage, or weakness. If defective, the spring must be replaced. Check the relief valve piston for scores and free operation in its bore.

Reassembly

If removed, refit the relief valve plunger and spring, and lubricate lightly with engine oil. Drive in a new sealing plug, flat side outwards, until it is flush with the pump face.

Lubricate the rotors and pump housing liberally with engine oil. Fit the pump cover, and tighten the retaining bolts progressively.

Fit the intermediate shaft into the rotor drive shaft, and check for free rotation of the rotors. Fit the oil pick-up pipe to the pump body, using a new gasket. Ensure that the pipe is correctly orientated in relation to the pump body. Tighten the bolts to their specified torque.

BALANCE SHAFT

Removal

1. Disconnect the vacuum line at the distributor. Remove the distributor cap. Remove the bolt securing the distributor to the cylinder block, and withdraw the distributor.
2. Disconnect the fuel line at the fuel pump outlet. Remove the two bolts securing the fuel pump to the cylinder block, detach the fuel pump and gasket, and withdraw the pump plunger (Fig. AB:33).
3. Remove the three retaining bolts, and detach the toothed belt guard from the front of the engine (Fig. AB:7).
4. Turn the engine to the TDC position. The pointer on the camshaft pulley belt guide plate should be aligned with the timing mark on the cylinder head (Fig. AB:9).
5. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt (Fig. AB:11.1).
6. Disengage the toothed belt from the balance shaft pulley.

NOTE: DO NOT move the crankshaft or camshaft while the toothed belt is removed.

7. Remove the three bolts securing the balance shaft cover plate to the cylinder block front face, and detach the cover with the oil seal.
8. Remove the two cross-head screws securing the balance shaft thrust plate to the cylinder block front face, and detach the thrust plate (Fig. AB:34).
9. Carefully withdraw the balance shaft from the cylinder block.

Inspection

Clean the balance shaft with petrol or other suitable solvent, and wipe dry. Inspect the shaft journals for scoring, or signs of abnormal wear. Check the teeth of the skew gear for wear, or damage. If present, the shaft must be replaced. In this case, the skew gear on the distributor should also be checked. Inspect the thrust plate for wear, and renew if necessary.

Installation

1. Lubricate the journals thoroughly, and insert the balance shaft into the cylinder block.
2. Fit the shaft thrust plate and secure with the two cross-head screws (Fig. AB:34).
3. Drive the old oil seal out of the balance shaft cover plate using a suitable punch (Fig. AB:21). Take care to avoid damaging the cover bore. Lubricate a new oil seal lightly with oil, and force it into position in the cover plate.
4. Clean all old gasket material from the mating faces of the cover plate and cylinder block. Fit the cover plate, using a new gasket. Cut off the surplus gasket which is not required. Tighten the cover bolts to their specified torque.
5. Refit the balance shaft pulley, and tighten the centre-bolt to its specified torque.
6. Ensure that the crankshaft and camshaft are in their correct positions as described in item 4 or removal, then fit the toothed belt on the pulley.

NOTE: If the crankshaft has been moved during this operation, it will be necessary to remove the Vee belt pulley from the crankshaft to determine that the crankshaft key is orientated towards the camshaft pulley as shown in Fig. AB:9.

7. Release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt.
8. Refit the drive belt guard.
9. Insert the fuel pump plunger into its guide bore in the cylinder block, and fit the fuel pump using a new gasket (Fig. AB:33). Tighten the pump retaining bolts to their specified torque.
10. Install the distributor, as described in IGNITION SYSTEM.

CRANKSHAFT AND BEARINGS

Removal

1. Slacken the alternator adjusting and mounting bolts, swing the alternator towards the engine, and detach the Vee belt from the pulleys.
2. Detach the toothed belt guard from the front of the engine.
3. Slacken the adjusting bolts at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt.
4. Disengage the toothed belt from the crankshaft and balance shaft pulleys.
5. Remove the centre-bolt and washer from the crankshaft, and withdraw the Vee belt drive pulley. Detach the thrust plate and toothed belt pulley from the crankshaft.
6. Remove the centre-bolt, and detach the pulley from the balance shaft.
7. Remove the flywheel.
8. Remove the sump and oil pump.
9. Remove the retaining bolts, and detach the front cover from the cylinder block.
10. Ensure that all bearing caps, both main and connecting rod, are suitably marked so that they can be installed in their original locations.
11. At each connecting rod in turn:

a) Turn the crankshaft, as necessary, to bring the connecting rod to the bottom of its travel.

b) Remove the two securing bolts, and detach the bearing

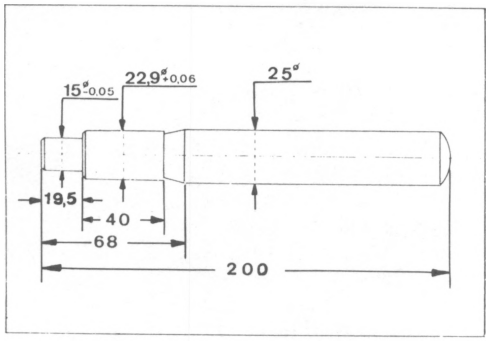


Fig. AB:38 Dimensions for spigot bearing tool

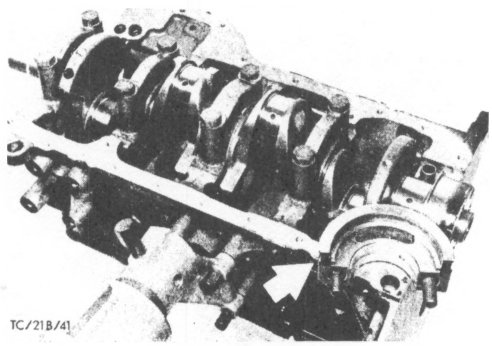


Fig. AB:40 Main bearing cap (sealer)

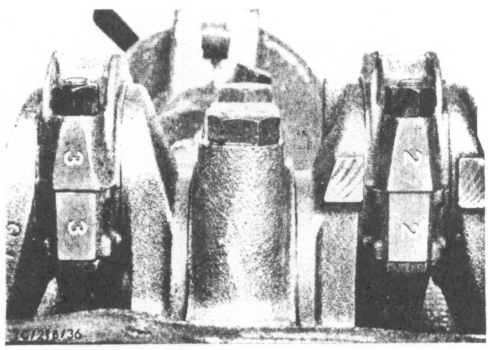


Fig. AB:42 Connecting rod and cap markings

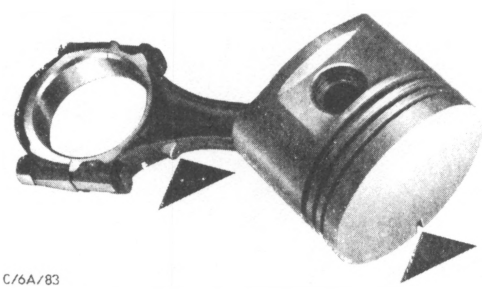


Fig. AB:44 Piston and connecting rod assembled positions

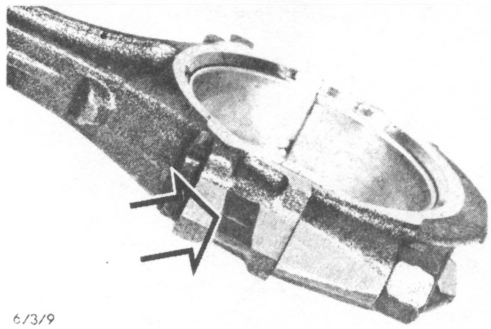


Fig. AB:39 Big end parent bore diameter

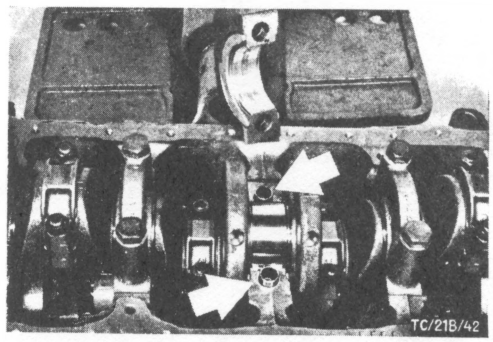


Fig. AB:41 Checking crankshaft end float

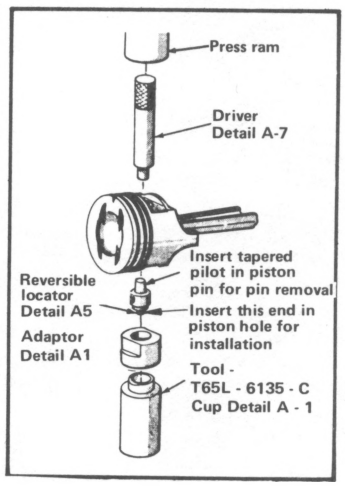

Press ram
Driver
Detail A-7
Insert tapered pilot in piston pin for pin removal
Reversible locator Detail A5
Insert this end in piston hole for installation
Adaptor Detail A1
Tool - T65L - 6135 - C Cup Detail A - 1

Fig. AB:43 Removing/Installing piston pin

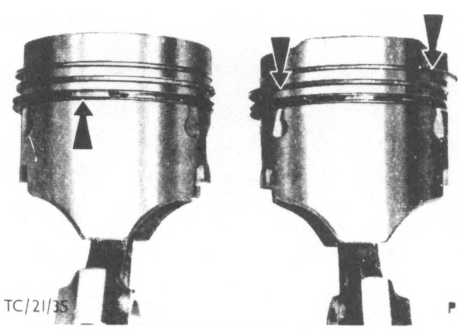


Fig. AB:45 Piston ring gap spacing

cap from the connecting rod.

c) Push the piston and connecting rod up the cylinder bore sufficiently to clear the crankshaft.

12. Release the main bearing cap retaining bolts, and detach the main bearing caps.

13. Carefully lift the crankshaft out of the crankcase.

14. Remove the main bearing inserts from the crankcase and bearing caps. Identify the inserts, if they are to be re-used.

15. Remove the bearing inserts from the connecting rods and bearing caps. Identify the inserts, if they are to be re-used.

16. Remove the oil seal from the rear of the crankshaft.

Inspection

Clean and inspect the crankshaft, and measure the diameter of each journal in the same manner, as described for the Type 'A' engine.

The crankshaft main bearing journals may either be of standard diameter or undersize, even in a new engine. Standard diameter journals are sub-divided into two further groups, which are identified by coloured paint marks. The smallest diameter is identified by a BLUE paint mark, and the largest by a RED paint mark. Where all the main bearing journals are within the same tolerance grade, a red or blue colour mark is to be found on the crankshaft web behind the centre bearing (Fig. AB:35). Where the journals vary in tolerance, the colour marks are to be found on the narrow side of the web behind the respective bearing, except for the rear journal where the mark is in front of the bearing (Fig. AB:36). Where the journals have been ground undersize, a coloured LINE is drawn on the foremost web (Fig. AB:37).

Clutch Pilot Bearing

On manual transmission models, the clutch pilot bearing is incorporated in the rear end of the crankshaft. The caged needle roller bearing is a press fit in the crankshaft bore, and should not be loose.

Inspect the bearing for roughness, wear, or evidence of overheating. If any of these conditions are found, the bearing must be replaced. Remove the old bearing, using a suitable extractor. Coat the crankshaft bore with a small quantity of wheel bearing grease, but do NOT use an excessive amount of grease, as it may be thrown onto the clutch disc in use. Install the new bearing, using a mandrel made up to the dimensions shown in Fig. AB:38.

Main and Big End Bearing Inserts

Clean and inspect the main and big end bearing inserts, as described for the Type 'A' engine.

The main bearing parent bore in the cylinder block may either be of standard diameter or 0,38 mm (0.015 in) oversize. Where an oversize exists, the letters 'OS' are stamped in the lower machined face of the cylinder block. The parent bore diameters are identified by the letters 'r' or 'b', also stamped in the machined face of the block. The smallest diameter is identified by the letter 'r' (RED), and the largest by the letter 'b' (BLUE).

The main bearing inserts for standard and 0,25 mm (0.010 in) undersize crankshaft journals are selective fit. The bearing inserts are identified by coloured paint marks, adjacent to the outer edge of the insert, in the same way as their respective main bearing journal.

Three sizes of bearing inserts which are non-selective fit, are available for main and big end journals which have been ground undersize. Oversize inserts are marked accordingly on their outside face.

Checking the Bearing Clearance

Check the main and big end bearing clearance, as described in the Type 'A' engine section.

Installation

1. Install the selected bearing inserts dry in the cylinder block and main bearing caps. Ensure the locating tag on the inserts correctly engages the notch in the housings and bearing caps.

2. Install the thrust washers on both sides of the centre main bearing, with the oil groove facing away from the centre bearing.

3. Coat the crankshaft journals and bearing inserts liberally with engine oil.

4. Carefully position the crankshaft in the cylinder block, and fit the main bearing caps in their respective locations. Apply a light film of sealing compound to the rearward portion of the rear main cap joint face, before fitting (Fig. AB:40).

5. Tighten the cap bolts of all, except the rear bearing cap, evenly to their specified torque.

6. Screw the bolts into the rear bearing cap, finger-tight only. Push the crankshaft first to the rear abutment, then slowly, but positively, to the front abutment, and retain in this position. This procedure is required to ensure that both bearing inserts in the rear bearing are loaded evenly. Now tighten the rear bearing cap bolts to their specified torque.

7. Using a dial indicator gauge, located with the stylus against the crankshaft flange, as shown in Fig. AB:41, check the crankshaft end-float. Push the crankshaft fully forwards, and zero the indicator. Now force the crankshaft towards the rear of the engine by levering on the crankshaft web with a screwdriver, and note the reading on the indicator. If the end-float exceeds the specified limit, the thrust washers must be replaced with ones of suitable oversize, to bring the figure within specification.

8. Lubricate the sealing lips of the new crankshaft rear oil seal with engine oil. Slide the seal onto the Rear Oil Seal Replacer, Service Tool No. 21.011, then drive it into its seat in the rear main bearing until it rests against the abutment.

9. **At each connecting rod in turn**

a) Install the selected bearing inserts dry in the connecting rod and cap. Ensure that the locating tag on the inserts correctly engages the notch in the bearing bore in the rod and cap.

b) Coat the crankshaft journal and bearing inserts liberally with engine oil.

c) Pull the connecting rod assembly down firmly onto the crankshaft journal, install the cap, and tighten the retaining bolts to their specified torque.

NOTE: The identification numbers on the connecting rod and cap must be on the same side of the assembly.

10. Lubricate the new crankshaft front oil seal lightly with oil, slide it onto the Oil Seal Replacer, Service Tool, No. 21.009, then force it into position in the front cover. Fit the front cover on the cylinder block face, using a new gasket, and tighten the retaining bolts to their specified torque.

11. Refit the oil pump, sump and flywheel, as described previously under the appropriate headings.

12. Refit the balance shaft pulley, and tighten the centre bolt to its specified torque.

13. Slide the toothed pulley onto the crankshaft.

14. Turn the engine to the TDC position, so that the key on the crankshaft is orientated towards the belt guide plate aligned with the timing mark on the cylinder head. Remove the distributor cap, and check that the rotor arm is pointing towards the No.1 HT contact in the cap, if not, turn the balance shaft as necessary to achieve this.

15. With the camshaft, crankshaft, and balance shaft in their correct positions, as described above, fit the toothed belt on the pulleys.

16. Release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt (Fig. AB:11).

17. Fit the thrust plate and Vee belt onto the crankshaft, and secure with the centre-bolt and large washer. The thrust plate is dished, and must be fitted with the convex side towards the toothed pulley (Fig. AB:23).

18. Refit the drive belt guard.

19. Refit the Vee belt, and adjust the tension, as described in the COOLING SYSTEM section.

PISTONS AND CONNECTING RODS

Removal

1. Detach the drive belt guard from the front of the engine. Slacken the adjusting bolt at the belt tension roller, swing the roller upwards against the spring pressure to relieve the load, and retighten the adjusting bolt. Disengage the toothed drive belt belt from the camshaft pulley.

2. Remove the rocker cover and gasket. With the aid of Cylinder Head Bolt Wrench, Service shown in Fig. AB:13. Lift off the cylinder head assembly and gasket.

3. Remove the sump and oil pump.

4. Ensure that all the connecting rods and caps are suitably marked with their cylinder numbers, so that they can be installed in their original location (Fig. AB:42).

5. For each piston and connecting rod in turn:-

a) Turn the crankshaft, as necessary to bring the connecting rod to the bottom of its travel.

b) Inspect the top of the cylinder bore for any carbon formation or wear ridge. If present, place a cloth on the piston crown to collect removed material, and scrape away the carbon deposits, taking care to avoid damaging the bore. Do not touch the piston travel zone. Remove the cylinder ridge with a ridge cutter, following the instructions of the tool manufacturer.

c) Partially remove the connecting rod cap bolts several turns, and tap them to release the cap. Completely remove the bolts, and detach the bearing cap from the connecting rod.

d) Push the piston and connecting rod up out of the cylinder bore using, the handle end of a hammer. Withdraw the assembly from the top of the cylinder bore.

e) Remove the bearing inserts from the cap and rod. Identify the inserts if they are to be re-used.

Dismantling

Remove the piston rings from the pistons. Using an arbor press and the tool shown in Fig. AB:43, press the piston pin from each piston and connecting rod assembly. Separate the pistons and connecting rods.

NOTE: Pistons and piston pins are a previously matched unit. Piston pins must not be interchanged between pistons. After removal, the piston pins and pistons should be suitably marked to ensure they are reassembled to the same connecting rod, and installed in the same cylinder from which they were removed.

Inspection

Clean and inspect the various removed components, in a similar manner to that described for the Type 'A' engine. Any points of difference or special note are given below:-

Cylinder Bores

In production, the cylinder bores may be either of standard diameter or 0,5 mm (0.02 in) oversize, even in a new engine. Standard bores are graded into four different tolerance groups, the smallest diameter being identified by the grade number 1, and the largest by the number 4. 0,5 mm (0.02 in). Oversize bores are graded into three tolerance groups, the smallest diameter being identified by the grade letter A, and the largest by the letter C. Pistons are selected and fitted to correspond to the cylinder bore grading, thus giving the correct working clearance. The piston grade number is stamped on the piston crown.

Pistons

In service, pistons are supplied in standard and two oversizes. When selecting replacement pistons, measure each cylinder bore at a point 70 mm (2.75 in) from the cylinder block top face across the crankshaft axis to determine the size of piston required. Measure the piston accurately at the piston pin bore centre-line, and at right angles to the piston bore. If necessary, hone the bore to obtain the correct fit.

When fitting oversize pistons, each cylinder bore must be machined to give the correct fit for the individual piston.

Big End Bearings

See "CRANKSHAFT AND BEARINGS".

Reassembly

For each piston and connecting rod in turn:-

a) Apply a light coat of engine oil to the piston pin, and the pin bores in the piston and connecting rod.

b) Assemble the piston to the connecting rod, with the oil hole in the connecting rod and the arrow on the piston crown positioned as shown in Fig. AB:44.

c) Heat the piston in water or oil to expand it, then start the piston pin in the piston and connecting rod. This may require a very light tap with a mallet. Using an arbor press and the tool shown in Fig. AB:43, press the piston pin through the piston and connecting rod until the pin is centred in the piston.

d) Fit the piston rings to the piston, the oil control ring first, followed by the lower, and then the upper compression rings. The oil control ring may be fitted either way round, but the compression rings must be fitted with the 'TOP' marking facing the piston crown.

Installation

1. For each piston and connecting rod in turn:

a) Check that the piston is correctly assembled to its respective connecting rod (Fig. AB:44).

b) Position the piston rings, with their gaps as shown in Fig. AB:45.

c) Lubricate the cylinder bore liberally with engine oil.

d) Install the assembly in its correct respective bore with the arrow on the piston crown pointing towards the front of the engine.

e) Compress the piston rings, using a piston ring compressor, and push the piston into the cylinder bore with the handle end of a hammer, until it is slightly below the top of the cylinder. Do NOT attempt to fit the pistons by hand, otherwise breakage of the rings may result.

NOTE: Take great care during this operation to avoid the connecting rod hitting and damaging the crankshaft journal.

f) Fit the bearing inserts dry in the connecting rod and cap. Ensure that the locating tag on the inserts correctly engages the notch in the bearing bore in the rod and cap.

g) Coat the crankshaft journal and bearing inserts liberally with engine oil.

h) Pull the connecting rod assembly down firmly onto the crankshaft journal, install the cap, and tighten the retaining bolts to their specified torque.

NOTE: The identification numbers on the connecting rod and cap must be on the same side of the assembly (Fig. AB:42).

2. Refit the oil pump and sump, as described previously under the appropriate headings.

3. Place a new cylinder head gasket on the cylinder block face, and install the cylinder head. The use of two guide studs, made up and screwed into the cylinder head bolt holes, as shown in Fig. AB:14, will facilitate correct alignment of the cylinder head and gasket. Once the head is installed, the studs are then replaced by the cylinder head bolts.

4. Tighten the cylinder head bolts evenly, using the Cylinder Head Bolt wrench, Service Tool No. 21.002. Tighten the bolts to their specified torque, in the sequence given in Fig. AB: 13.

5. Fit the rocker cover using a new gasket. Ensure that the dove-tail on the gasket is correctly seated in its recess. Tighten the rocker cover bolts in the sequence shown in Fig. AB: 7.

6. Turn the engine to the TDC position. Position the camshaft with the pointer on the belt guide plate aligned with the timing mark on the cylinder head (Fig. AB:9). Remove the distributor cap, and check that the rotor arm is pointing towards the No.1 HT contact in the cap. If not, turn the balance shaft, as necessary, to achieve this.

7. With the camshaft, crankshaft and balance shaft in their correct positions, as described above, fit the toothed belt on the pulleys.

8. Release the tension roller adjusting bolt, turn the engine twice, then tighten the adjusting bolt.

9. Refit the drive belt guard.

Technical Data

GENERAL

NOTE: Figures are listed in mm. (in.), except where otherwise stated.

Identification	
1600	LEA
2000 HC	NEA
Bore 1600	87,65 mm (3.541 in)
2000	90,8 mm (3.575 in)
Stroke 1600	66 mm (2.6 in)
2000	76,95 mm (3.03 in)
Displacement 1600	1593 cc
2000	1993 cc
Compression ratio	9,2:1
Compression pressure - average operating pressure 1600	10/12 atu (142/170 psi)
2000	10/12 atu (142/170 psi)
Brake horsepower (DIN-ps at rev/min.) 1600	72/5,500
1600 GT	88/5,700
2000	98/5,500
Torque (DIN at rev/min.) 1600	11.89 mkp/86 lb.ft. 2,700
1600 GT	12,7 mkp/91 lb.ft. 4,000
2000	15,4 mkp/110 lb.ft. 3,500
Max. continuous engine speed (rev/min.) 1600	6,300
2000	5,850
Idling speed (rev/min.) 1600 / 2000	725 - 775 rpm / 675 - 725 rpm
Firing order	1 - 3 - 4 - 2
Cylinder numbering	From front
Initial ignition timing (Static) 1600	6° BTDC
2000	4° BTDC
Oil pressure (min. at 1,500 rev/min.)	2,5 kg/cm^2 (36 p.s.i.)

CYLINDER BLOCK

Identification 1600	16
2000	20

PISTONS

	mm.	in.
Piston dia. 1600		
tolerance grades for standard pistons in production:-		
Grade 1	87,605 - 87,615	(3.4490 - 3.4494)
2	87,615 - 87,625	(3.4494 - 3.4498)
3	87,625 - 87,635	(3.4498 - 3.4502)
4	87,635 - 87,645	(3.4502 - 3.4506)
pistons supplied in service:		
Standard	87,630 - 87,655	(3.4500 - 3.4510)
Oversize 0,5 (0.02)	88,130 - 88,155	(3.4697 - 3.4707)
1,0 (0.04)	88,630 - 88,655	(3.4894 - 3.4904)
Piston dia. 2000		
tolerance grades for standard pistons in production:		
Grade 1	90,755 - 90,765	(3.5730 - 3.5734)
2	90,765 - 90,775	(3.5734 - 3.5738)
3	90,775 - 90,785	(3.5738 - 3.5742)
4	90,785 - 90,795	(3.5742 - 3.5746)
pistons supplied in service:		
Standard	90,780 - 90,805	(3.5740 - 3.5750)
Oversize 0,5 (0.02)	91,280 - 91,305	(3.5937 - 3.5947)
1,0 (0.04)	91,780 - 91,805	(3.6134 - 3.6144)
Piston to bore clearance	0,035 - 0,055	(0.0014 - 0.0022)

PISTON RINGS

Ring end gap	Compression rings	0,38 - 0,58 (0.015 - 0.023)
	Oil control ring	0,4 - 1,4 (0.0157 - 0.055)

CONNECTING RODS

Bearing insert inside dia:			
Standard	RED	52,014 - 52,038	(2.0478 - 2.0487)
	BLUE	52,004 - 52,028	(2.0474 - 2.0483)
Undersize	0,25 (0.010) RED	51,764 - 51,788	(2.0379 - 2.0388)
	BLUE	51,754 - 51,778	(2.0376 - 2.0385)
	0,50 (0.020)	51,514 - 51,548	(2.0281 - 2.0294)
	0,75 (0.030)	51,264 - 51,298	(2.0183 - 2.0196)
	1,00 (0.040)	51,014 - 51,048	(2.0084 - 2.0100)
Bearing to Crankpin clearance:			
Stand	Standard	0,014 - 0,048	(0.00055 - 0.0018)
	Undersize	0,014 - 0,058	(0.00055 - 0.0023)

CRANKSHAFT

Main bearing journal dia:			
Standard	RED	56,990 - 57,000	(2.2437 - 2.2441)
	BLUE	56,980 - 56,990	(2.2433 - 2.2437)
Crankshaft end-float		0,08 - 0,28	(0.0032 - 0.0110)
Thrust washer thickness:			
Standard		2,3 - 2,35	(0.091 - 0.0925)
Oversize		2,5 - 2,55	(0.098 - 0.100)

CAMSHAFT

Identification	Yellow
End-float	0,05 - 0,09 (0.002 - 0.0035)
Thrust plate thickness:	
Type 1	4,01 (0.158)
Type 2	3,98 (0.157)
Valve timing:	
Inlet opens	18° BTDC
Inlet closes	70° ABDC
Exhaust opens	64° BBDC
Exhaust closes	24° ATDC

CYLINDER HEAD

Identification 1600 GT	6
2000	0
Combustion chamber volume 1600 GT	37,5 - 39 cc.
2000	45,75 - 47,25 cc.

VALVES

	mm. in.
Valve clearances	
Inlet valves	0,20 (0.008)
Exhaust valves	0,25 (0.010)

LUBRICATION SYSTEM

Oil pump - inner to outer rotor clearance	0,05 - 0,20 (0.002 - 0.008)
outer rotor to housing clearance	0,15 - 0,30 (0.006 - 0.012)
rotor end - float	0,03 - 0,10 (0.0012 - 0.004)
Oil pressure (min) - at 700 rev/min.	1,1 kp/cm^2 (16 psi.)
at 1,500 rev/min.	2,5 kp/cm^2 (36 psi.)
Relief valve opens at	4,0 - 4,7 kp/cm^2 (57-67 psi.)

Cooling System

GENERAL
FAN DRIVE BELT
DRAINING AND REFILLING
TESTING THE COOLING SYSTEM
THERMOSTAT
RADIATOR

GENERAL

The pressurised cooling system is of the impeller-assisted, thermo-syphon type. The centrifugal water pump is mounted on the front face of the cylinder block, and belt driven from the crankshaft in common with the alternator. A cooling fan, mounted on the water pump pulley, provides additional air-flow through the radiator.

To promote rapid warming up of the engine and also maintain a reasonably constant operating temperature, a wax-type thermostat, fitted in the water outlet housing on the cylinder head, restricts the flow of coolant to the radiator top tank until the engine has reached a pre-determined temperature. While the thermostat is closed, a by-pass tube allows the coolant to circulate internally within the engine.

The coolant temperature is recorded electrically by a gauge on the car instrument panel, and is measured by a temperature sensitive sender unit screwed into a tapping in the cylinder head. The engine coolant is utilised as a source of heat for the interior heater, and the water heater inlet manifold, where fitted. On models with an automatic choke carburettor, the choke housing is also connected to the engine cooling system.

FAN DRIVE BELT

Correct tensioning of the fan drive belt is important to ensure efficient operation of the cooling and electrical systems. Excessive tension will cause rapid wear of the belt, and place undue strain on the water pump and alternator bearings.

1. The belt is correctly tensioned when a total free movement of 13 mm (0.5 in) is present at the point midway between the water pump and alternator pulleys (Fig. B:1).
2. If adjustment is required, slacken the alternator mounting and adjusting arm bolts, and move the alternator towards, or away from the cylinder block, as necessary, until the correct belt tension is obtained (Fig. B:2).
3. Retighten the adjusting arm and mounting bolts, and recheck the belt tension.

NOTE: The condition of the belt should be checked periodically. If nicked, cut, excessively worn, or otherwise damaged, the belt should be replaced. If the belt is noisy in operation, check for misaligned pulleys.

4. To replace the belt, proceed as for adjusting, but press the alternator fully towards the cylinder block, and detach the belt from the pulleys. Fit the new belt, ensuring that it is not twisted, and adjust the tension, as described above. Do NOT attempt to lever a new belt onto the pulleys, as this can easily cause damage to the belt or pulleys. The tension of a new belt should be rechecked after approx. 160 km (100 miles) use.

COOLING SYSTEM - Draining

Two drain points are provided in the cooling system; a drain cock at the bottom of the radiator (Fig. B:3) and a drain plug on the side of the cylinder block. For most applications, except where it is required to completely drain the cylinder block. It will suffice to drain the cooling system by opening only the radiator drain point.

NOTE: On later models there is no facility for draining the cooling system at the radiator. To drain the new system disconnect the bottom hose, radiator (Fig. B:3).

1. Where a red pressure relief button is incorporated in the radiator cap, press this button to relieve the internal pressure in the system, before removing the cap. Do not attempt to remove the radiator cap when the engine is very hot, as there is a danger of scalding. Allow it to cool sufficiently first.
2. If the system contains an anti-freeze solution and it is required for re-use, the coolant be drained into a clean container.
3. Set the interior heater control to "HOT", open the radiator drain cock, and remove the radiator cap. If required, remove the drain plug from the cylinder block drain point.
4. When the system is completely drained, probe the drain points with a piece of wire, to ensure that sediment or scale has not prevented the entire contents from draining away.

NOTE: If the car is to be left standing with the cooling system drained, it is advisable to leave an indication to this effect.

Flushing

When it is found necessary to remove the build up of rust, sludge or other foreign material from the cylinder block or radiator, the use of a commercial radiator cleaner is recommended. Follow the solvent manufacturers instructions. If cleaning solvent will not properly clean the system, the system should be pressure flushed. In extreme cases, flush the cylinder block, and interior heater separately, in the reverse direction to the normal coolant flow.

Refilling

5. To refill the system, close the drain point(s), and check that the heater control is set to "HOT". If the system is being filled with anti-freeze solution, dilute in accordance with the anti-freeze manufacturers instructions.
6. Fill the system slowly to avoid air locks. Run the engine up to normal operating temperature without the radiator cap, to release any air trapped in the system. Check the coolant level; add coolant as necessary to bring the level approx. 25 mm (1.0 in) below the bottom of the filler neck. Run the engine with the radiator cap fitted, and check for air leaks.

NOTE: After the engine has been run for approx. 2 minutes at 2,000 rev/min. the coolant level may drop by as much as 1 litre (2 pts), due to the displacement of entrapped air. Refill to the correct level.

Testing

The cooling system can be easily tested for leaks, using a suitable pressure tester.

1. Remove the radiator cap, fit the tester in its place, and pressurize the system (Fig. B:4).

NOTE: Never exceed the rated pressure indicated on the radiator pressure cap when performing the pressure test.

2. If the pressure drops once the system has been pres-

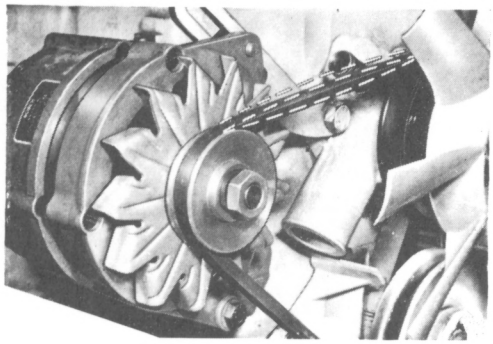


Fig. B:1 Checking drive belt tension

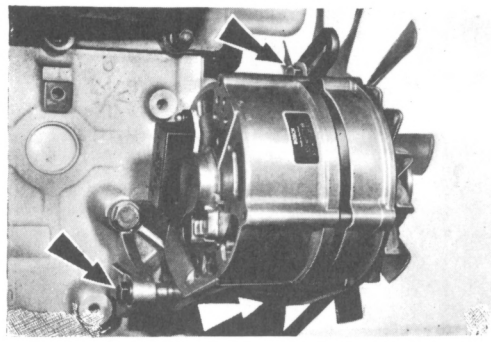
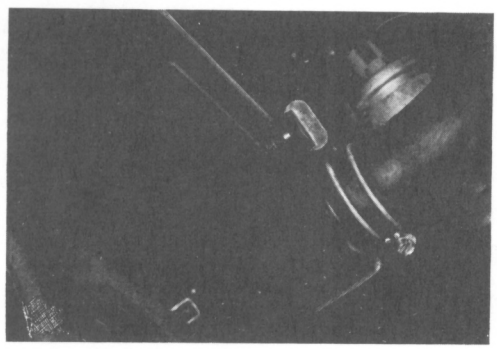
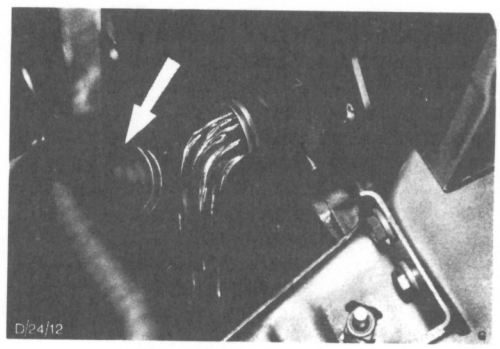


Fig. B:2 Alternator mounting and adjusting bolts



OHV engine



OHC engine

Fig. B:3 Radiator drain cock

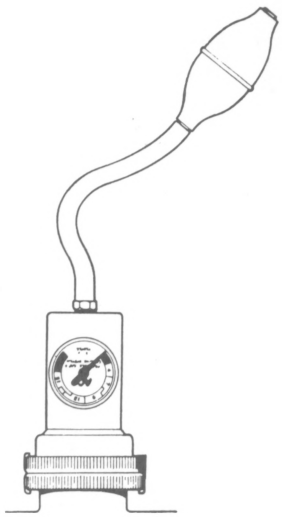


Fig. B:4 Pressure testing cooling system

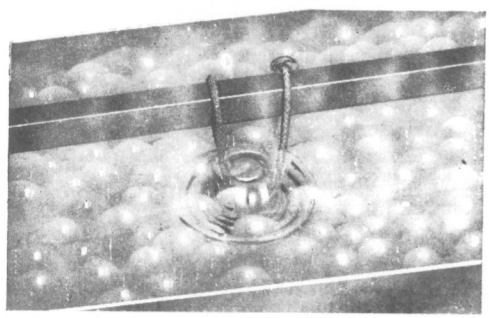


Fig. B:6 Testing operation of thermostat

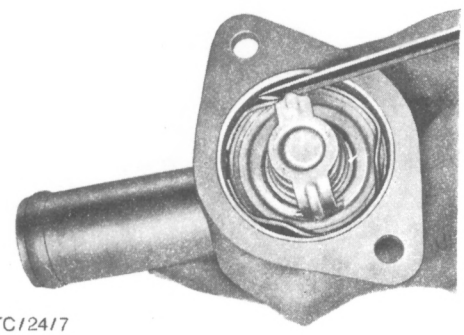


Fig. B:5 Extracting thermostat retaining clip - OHC engine

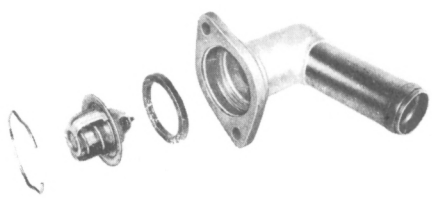


Fig. B:7 Water outlet housing, thermostat, seal and spring clip - OHC engine

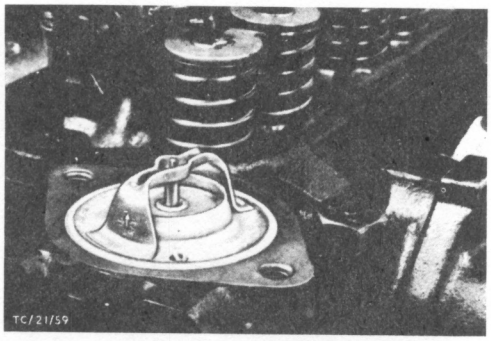


Fig. B:8 Thermostat installation - OHV engine

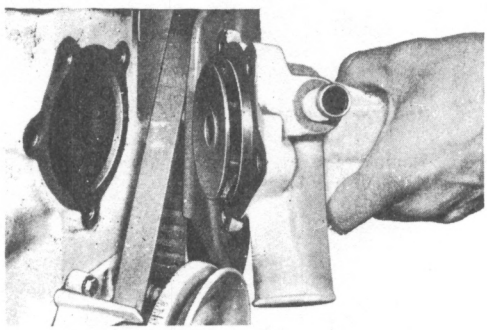


Fig. B:10 Water pump removal - OHC engine

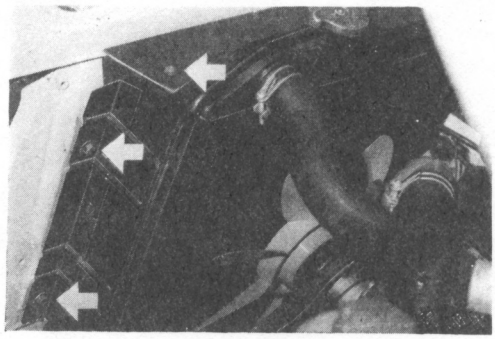


Fig. B:9 Radiator retaining bolts

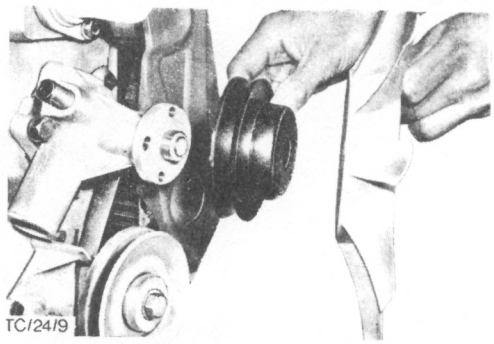


Fig. B:11 Removing cooling fan and pump drive pulley

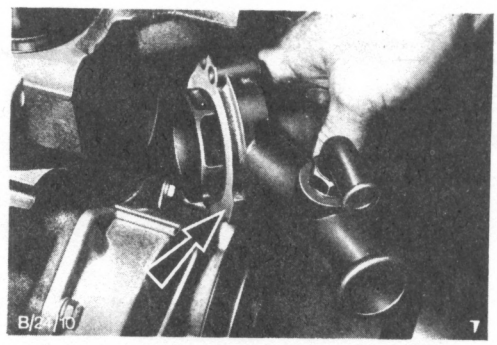
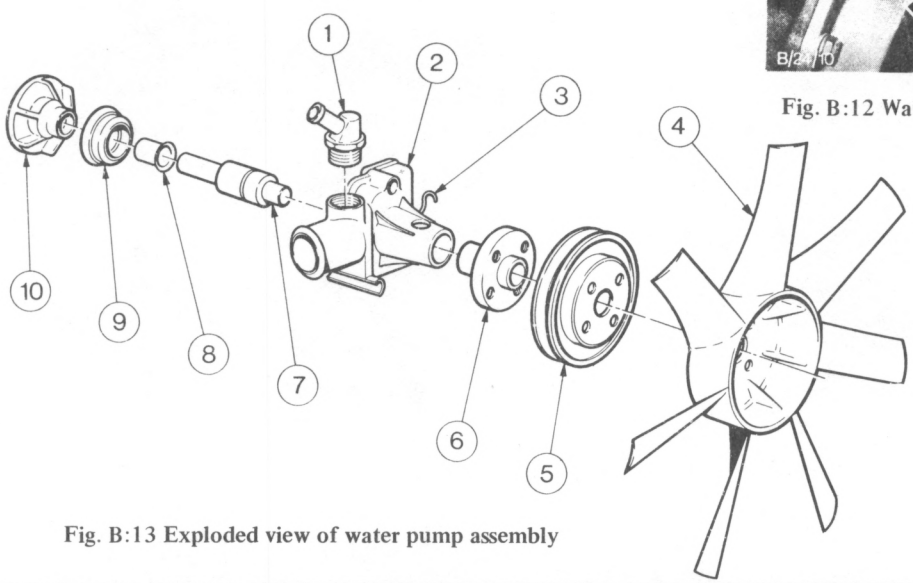


Fig. B:12 Water pump removal - OHV engine



1. *Heater connection*
2. *Pump body*
3. *Bearing retainer*
4. *Cooling fan*
5. *Fan pulley*
6. *Pulley hub*
7. *Shaft and bearing assembly*
8. *Slinger*
9. *Seal assembly*
10. *Impeller*

Fig. B:13 Exploded view of water pump assembly

surized, visually inspect all joints and connections for leaks. If no external leaks are apparent, but the pressure continues to drop, inspect the engine oil on the dipstick for water droplets to determine whether or not the coolant is leaking into the crankcase. If present, this is propaply due to a leaking cylinder head gasket, or a cracked cylinder block or head.

3. To check for compression or combustion leakage into the cooling system, run the engine until it reaches normal operating temperature. With the engine running, pressurize the system with the tester, and observe the tester dial. Any fluctuation of the needle indicates a compression or combustion leak.

4. To locate the leaking cylinder, disconnect each of the spark plug leads in turn, and observe the tester dial. The indicator will stop fluctuating when the lead is removed from the offending cylinder. If more than one cylinder is leaking, the fluctuations will become less frequent when the spark plug lead is removed from one of the offending cylinders.

5. The radiator cap can also be tested for proper operation, using the pressure tester. Inspect the rubber sealing ring on the cap for perishing or damage. If satisfactory, wet the sealing ring to ensure an air-tight seal, and attach the cap to the tester. Give the pump several strokes to seat the valve, and continue pumping. The cap should be capable of retaining pressure up to its indicated rating. The rating is normally marked on top of the cap. A cap with a weak spring or defective sealing ring will cause excessive loss of coolant. The radiator cap has an important effect on the correct functioning of the cooling system, and should be replaced if suspect. Ensure that the replacement cap has the same rating as that of the original.

THERMOSTAT

The wax-type thermostat is located in the water outlet housing on the cylinder head. A defective thermostat will cause overheating if jammed shut, and excessive warm up time if jammed open. No attempt should be made to repair the thermostat. If defective, or even suspect, it should be replaced. Ensure that the replacement is of the specified rating.

Removal

1. To remove the thermostat, open the radiator drain cock, and drain the cooling system to below the level of the water outlet housing (Fig. B:3).

2. Remove the two bolts securing the housing to the cylinder head, and push the housing to one side, with the radiator hose still attached.

On O.H.C. engines, the thermostat is retained in the water outlet housing by a spring clip. Prise the clip from the housing, and extract the thermostat and seal (Fig. B:5)

On all other engines, lift the thermostat out of the recess in the cylinder head.

Testing

1. The operation of the thermostat can be tested, by suspending it fully submerged, along with a suitable thermostat, in a container of water or anti-freeze solution (Fig. B:6). Both the thermostat and the thermometer should be suspended in such a way that they do not touch the sides of the container.

2. Heat the water gradually, and observe the function of the thermostat. The temperatures at which the thermostat valve begines to open, and is fully open, should both be within the specified limits. See TECHNICAL DATA for specifications. If the thermostat does not function correctly, it must be replaced.

NOTE: It is good practice to test a new thermostat before installing it in the engine.

Installation

1. Clean all old gasket material from the surfaces of the water outlet housing and the cylinder head.

2. On O.H.C. engines, install the thermostat and seal assembly in the water outlet housing, and secure with the spring clip (Fig. B:7). Ensure that the thermostat is positioned in the housing so that the heat element will be in the cylinder head.

3. Coat a new gasket with sealer, and position it on the cylinder head face. Fit the water outlet housing, and secure with the two retaining bolts.

4. On O.H.V. engines, install the thermostat in the cylinder head, with the stamped arrow on the side pointing upwards (Fig. B:8).

5. Coat a new gasket with sealer, and position it on the cylinder head face. Fit the water outlet housing and secure with the two retaining bolts.

NOTE: In each case, it is important that the thermostat be properly positioned in the engine, otherwise overheating will result.

6. Top up the cooling system. Run the engine up to normal operating temperature, and check for leaks. Recheck the coolant level.

RADIATOR - Removal

1. Open the radiator drain cock, and drain the cooling system.

2. Disconnect the radiator hoses at the radiator. Remove the radiator retaining bolts (Fig. B:9) and lift out the radiator and shroud (where fitted).

NOTE: If the radiator is being exchanged, transfer the drain cock, overflow pipe and nylon pipe connection to the new radiator.

Installation

Install the radiator in the reverse order of removal. Refill the cooling system. Run the engine up to normal operating temperature, and check for leaks.

WATER PUMP - Removal

Drain the cooling system, and remove the radiator, as described above.

2. Slacken the alternator, mounting and adjusting arm bolts, pivot the alternator towards the engine, and remove the drive belt from the pulleys.

3. Remove the four securing bolts and washers, and detach the cooling fan and drive pulley from the water pump hub (Fig. B:11).

4. Disconnect the heater hose at the water pump. Remove the pump retaining bolts, and detach the water pump and gasket from the front face of the cylinder block.

Overhaul

Overhaul of the water pump requires specialised service tools which the normal owner-driver is unlikely to possess. It is therefore recommended that, as the water pump is a relatively inexpensive item, the pump be exchanged for a new or reconditioned unit if damaged or defective in any way.

Installation

1. Clean all old gasket material from the mating faces of the water pump and cylinder block. Coat a new gasket on both sides with water resistant sealer, and position it on the cylinder block face.

2. Fit the water pump to the cylinder block, and secure with the retaining bolts. Note that the alternator adjusting arm is also secured by one of the pump fixing bolts.

3. Reconnect the heater hose. Fit the drive pulley and cooling fan to the pump hub, and secure with the four bolts and washers. Fit the fan belt, and adjust the tension as described previously under "FAN DRIVE BELT".

4. Install the radiator, reconnect the hoses, and refill the cooling system. Run the engine up to normal operating temperature, and check for leaks.

Technical Data

SYSTEM CAPACITY (INC. HEATER)

	Litres	Imp. Pts.
1300 (OHV)	4.96	8.73
1600 (OHV)	5.4	9.5
1600 (OHC)	5.76	10.15
2000 (OHC)	6.13	10.8

DRIVE BELT TENSION

Total free movement.....13 mm (0.5 in)
Tension.....18 - 22 kg (40 - 50 lb.)

RADIATOR CAP RELEASE PRESSURE.....0.91 kg/sq.cm (13 psi.)

THERMOSTAT

Starts to open.....85 - 89°C (185 - 192°F)*
Full open.....99 - 102°C (210 - 216°F)*

* Add +/- 3°C (5-5°F) for used thermostats

SPECIFIED ANTIFREEZE.... Ford anti-freeze plus part no. M97B18-C

WATER PUMP

Type.....Centrifugal
Delivery at 5,000 rev/min
1300 & 1600 (OHV).....136 Litres/min (235 pts/min.)
1600 & 2000 (OHC).....200 Litres/min (352 pts/min.)
Pulley to crankshaft ratio...1.125 : 1

Ignition System

GENERAL
CONTACT BREAKER POINTS
CONDENSER
IGNITION TIMING
SPARK PLUGS
DISTRIBUTOR
TECHNICAL DATA

GENERAL

The ignition system is a conventional battery-coil type, and consists of a ballast resistor coil, distributor, and spark plugs. The primary circuit provides the battery feed through the ignition switch to the ignition coil. A high resistance wire is included in the coil feed circuit, and thus it is essential that only a 'ballast resistor' type ignition coil is used. The ballast resistor system is used in conjunction with a starter solenoid having an extra terminal. A wire from the solenoid to the ignition coil feeds directly to the coil when the starter is operated, thus by-passing the resistor wire and applying full battery voltage to the ignition system to facilitate starting (Fig. C:1).

The oil-filled ignition coil comprises a series of primary and secondary windings around an iron core. When the contact breaker points open, the circuit is broken and the field in the primary windings collapses, inducing a high tension current in the secondary windings. The secondary circuit feeds this H.T. current to the distributor where it is supplied, in rotation, to the spark plugs. The high tension leads in the secondary circuit are of the suppressor type.

The Autolite distributor incorporates both centrifugal and vacuum advance mechanisms. The centrifugal mechanism regulates the ignition advance according to engine speed, while the vacuum control acts according to engine load. Different distributors are used for each engine, and reference should be made to TECHNICAL DATA at the end of the section for details of model application and component identification.

On O.H.V. engines (1300 and 1600), the distributor is mounted on the R.H. side of the cylinder block, and is driven by a skew gear from the camshaft.

On O.H.C. engines (1600 & 2000), the distributor is mounted on the front L.H. side of the cylinder block, and is driven by a separate auxiliary shaft.

CONTACT BREAKER POINTS - Inspection

1. The contact breaker points should be replaced if they are badly burned or pitted, or if excessive metal transfer has occured. Metal transfer is considered excessive when it equals or exceeds the recommended gap setting.
2. After considerable use, the contact surfaces may show a greyish colour and slight signs of pitting but they need not be replaced, as satisfactory service will be provided until most of the tungsten is worn off. Oxidised points may be caused by oil contamination on the contact surfaces, a defective condenser, or a loose connection in the primary circuit. Check for these conditions when burned contacts are encountered.
3. If the contact points are to be retained, they should be dressed with a clean, fine-cut points file. Never use emery cloth to clean the contact points. Points which have become dirty, or contaminated with oil or grease, should be cleaned with a stiff brush and carbon tetrachloride.

Adjustment

1. The contact points can be set, either by measuring the gap between the points with a feeler blade, or by measuring the dwell angle with a dwell meter. Where possible, and especially in the case of used points, the use of a dwell meter is recommended, as this is a more accurate method of setting the points.
2. Ensure that the faces of the points abut squarely. Any misalignment of the breaker points surfaces will cause premature wear, over-heating, and pitting. If necessary, align the points to make full-face contact by bending the fixed contact bracket. Do NOT bend the breaker arm.
3. Check the breaker arm spring tension, using a spring tension scale hooked over the moving breaker point. Pull the gauge at right-angles to the breaker arm until the points just start to open. If the spring tension is too great, rapid wear of the breaker arm rubbing block will result, causing the points to close up and retard the ignition timing. If the tension is too weak, points bounce will occur at high engine speed, resulting in misfiring. The breaker points assembly is of the pivotless-type, and should be replaced if the tension is not within specification.
4. To set the contact points gap using a feeler blade, remove the distributor cap and rotor arm. Crank the engine until the breaker arm rubbing block is resting on the highest point of the cam lobe.
5. Slacken the fixed contact plate retaining and adjusting screws, and adjust the position of the contact plate until a gap of 0.64 mm (0.025 in) is obtained between the contact points. The feeler blade should pass easily between the contact without gripping (Fig. C:4). Recheck the gap after tightening the retaining and adjusting screws. Refit the rotor arm and distributor cap.

NOTE: When measuring used contact breaker points where a pip has formed on the face of one contact, the gap measurement should be made outside the formation to obtain a correct reading.

6. To set the contact points using a dwell meter, connect the meter in accordance with the equipment manufacturer's instructions. With the engine running at approx. 1,000 rev/min, read off the dwell angle indicated on the meter. This should be $39^{o} + - 1^{o}$. If the dwell angle is outside the specified limit, adjust the points gap, as described above. If the indicated reading is below specification, the breaker gap is too small and should be increased. Similarly, if the reading is above the limit, the gap is too large and should be reduced. Recheck the dwell angle after adjustment of the points gap.

NOTE: If new points have been fitted, set the points gap to the wide limit, as the rubbing block will wear down while seating to the cam.

Replacement

1. Remove the distributor cap and rotor arm.
2. Slacken the retaining screw, and disconnect the primary and condenser leads from the contact breaker assembly.
3. Unscrew the retaining and adjusting screws, and lift off the contact breaker assembly (Fig. C:5).

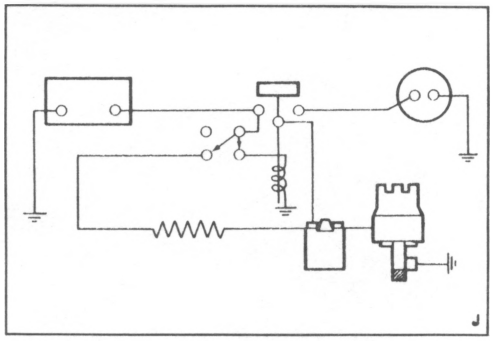


Fig. C:1 Ballast resistor ignition system

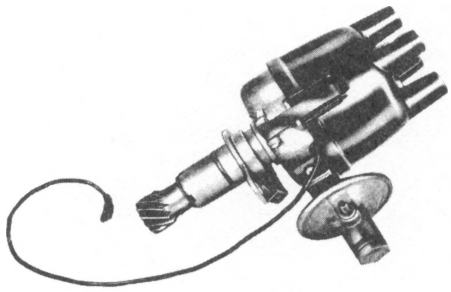


Fig. C:2 Autolite distributor

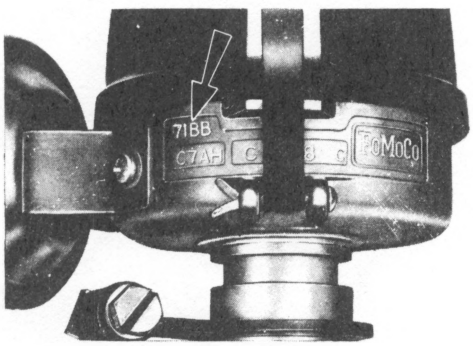


Fig. C:3 Distributor identification number

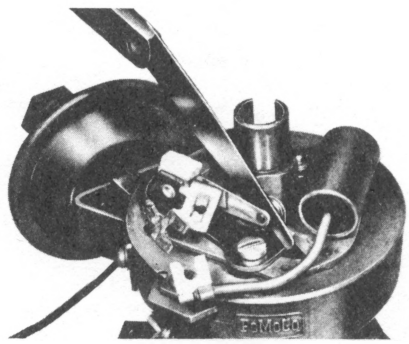


Fig. C:4 Contact breaker points adjustment

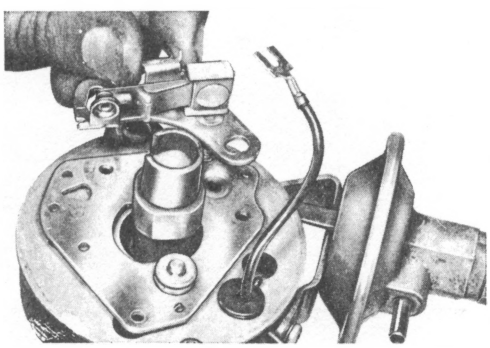


Fig. C:5 Replacing contact points assembly

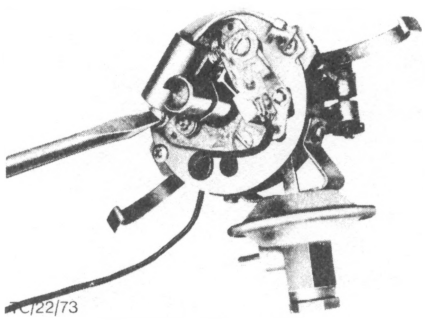


Fig. C:6 Replacing condenser

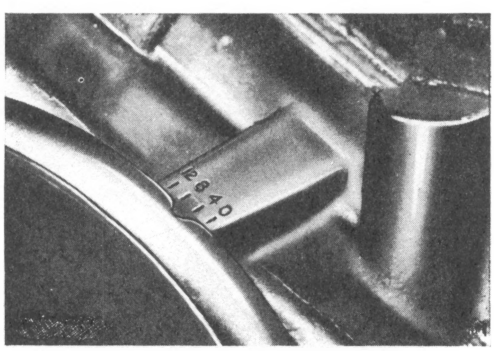


Fig. C:7 Ignition timing scale - OHV

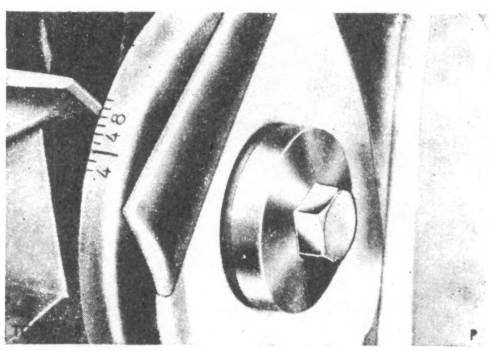


Fig. C:8 Ignition timing scale - OHC

4. Apply a light film of petroleum jelly or distributor cam lubricant (ESF-MK66-A Grease) to the contact breaker cam. Distribute the lubricant uniformly over the cam surface so that, when the cam is rotated a small amount of lubricant is deposited on the block of the contact heel.

5. Position the new contact breaker assembly on the breaker plate, and lightly retain in position with the two screws.

6. Connect the primary and condenser leads to the contact breaker assembly, and secure in position.

7. Check the alignment of the breaker contacts, and set the contact gap, as described previously.

CONDENSER

The condenser is connected across the contact breaker points, and serves to increase the current peak in the primary windings of the ignition coil when the points are open. This in turn boosts the high tension supply to the spark plugs. A further function of the condenser is to minimise erosion and oxidation of the breaker contact surfaces. As the condenser is a relatively inexpensive item, it should be replaced if in any way suspect. Excessive wear or burning of the points are indications that the condenser is defective.

Replacement

1. Slacken the retaining screw, and disconnect the condenser lead from the contact breaker assembly.

2. Remove the screw retaining the condenser to the breaker plate, and lift out the condenser (Fig. C:6).

3. Install the new condenser, and secure in position with the retaining screw.

4. Connect the condenser lead to the contact breaker assembly, and tighten the securing screw.

IGNITION TIMING

The use of a stroboscopic timing light is recommended, to ensure accurate setting of the ignition timing. However, if the timing has not been previously set (i.e. After engine overhaul or re-installation of the distributor), the basic setting must first be obtained, as described below. In either case, the contact breaker points gap must be correctly adjusted before attempting to set the ignition timing.

Basic Setting

1. Turn the crankshaft until No. 1 piston is coming up to T.D.C. on the compression stroke. This can be determined by removing the spark plug from No. 1 cylinder, and feeling the pressure developed at the spark plug hole.

2. Continue turning the crankshaft until the appropriate timing marks on the crankshaft pulley and timing gear cover are aligned (Fig. C:7 and C:8). The initial setting is 4^{O} BTDC for all other engines.

NOTE: If the vehicle is normally operated at a high altitude, the initial setting may be advanced by 4^{O} (crankshaft) for each 610 metres (2,000 ft) above sea level up to a maximum of 12^{O}. Where the vehicle is used at varying altitudes, the initial advance must be set for the lowest altitude at which the car will will be operated.

3. Remove the distributor cap.

4. Slacken the distributor clamp bolt and turn the distributor body, as necessary, until the contact breaker points are just opening with the rotor arm pointing towards the No. 1 HT contact in the distributor cap.

The opening point can be determined either by observing the spark when the points open, or by connecting a 12 volt test lamp between the distributor low tension terminal and a good earthing point, and observing the point at which the lamp just illuminates.

In both cases, the ignition must be switch on during this operation. When the correct setting has been obtained, lightly tighten the distributor clamp bolt.

Final Setting

1, Connect a stroboscopic timing light in accordance with the equipment manufacturers instructions.

NOTE: No 1 cylinder is at the front.

2. Check that the appropriate timing marks on the crankshaft pulley and timing gear cover are visible. Mark with paint or chalk, if necessary.

3. Disconnect the vacuum line from the distributor.

4. Start the engine and allow to idle.

5. Point the timing light at the timing scale (Fig. C:9). The mark on the crankshaft pulley should be adjacent to the mark on the timing gear cover.

6. If the timing is incorrect, slacken the distributor clamp bolt and rotate the distributor body until the marks are aligned. Recheck the setting after retightening the clamp bolt.

7. Remove the timing light, and reconnect the vacuum line.

SPARK PLUGS

1. The spark plugs should be removed and examined. When disconnecting the leads from the spark plugs, grasp the moulded cap of the wire, then twist and pull the cap off the plug. Do NOT pull on the wire, otherwise the connection inside the cap may become separated. Brush or blow any dirt away from around the plug, before removing.

2. After the sparking plugs are removed their condition should be checked. In many cases the appearance of the electrodes can help in identifying other problems with the engine. Listed below are some of the conditions likely to be found. Compare the descriptions with the photographs, kindly supplied by Champion Sparking Plugs, shown in Fig. C:12 for easy identification.

NORMAL: Light brown or grey deposits on the firing tip. Can be cleaned. (Fig. C:12.1).

HEAVY DEPOSITS: Deposit build-up closing the gap between the electrodes. Cause can be due to fuel or oil additives or perhaps excessive upper cylinder lubricant. Worn valve guides can also contribute to this condition. Provided that the sparking plug isn't worn it should be able to be used again after cleaning and servicing. Sometimes this condition can be traced to just one cylinder. (Fig. C:12.2).

CARBON-FOULED: Dry, black, fluffy deposits on the insinsulator tip and electrodes. Caused by too cold a grade of plug, weak ignition, dirty air cleaner element, defective fuel pump, over-rich fuel mixture, or excessive idling (Fig. C:12.3).

OIL-FOULED: Wet, black deposits on the insulator and electrodes. Caused by excessive oil entering the combustion chamber due to worn rings, pistons or bores, excessive valve guide clearance, or worn or loose bearings. Can be cleaned. If the engine is not to be repaired, use a hotter grade of plug (Fig. C:12.4).

OVER-HEATING: White or light grey insulator with small black or grey-brown spots. Also bluish burnt appearance of the electrodes. Caused by engine over-heating, wrong grade of fuel, incorrectly tightened spark plugs, too hot a grade of plug, low fuel pump pressure, or incorrect ignition timing (Fig. C:12.5).

PRE-IGNITION: Melted electrodes and possibly a blistered insulator. Metallic deposits on the insulator indicate engine damage. Caused by wrong grade of fuel, incorrect ignition timing or advance, too hot a grade of plug, burnt valves, or engine overheating. Renew. (Fig. C:12.6).

Plugs should be cleaned by a sand blasting machine which is designed to be more efficient. However spark plugs can be

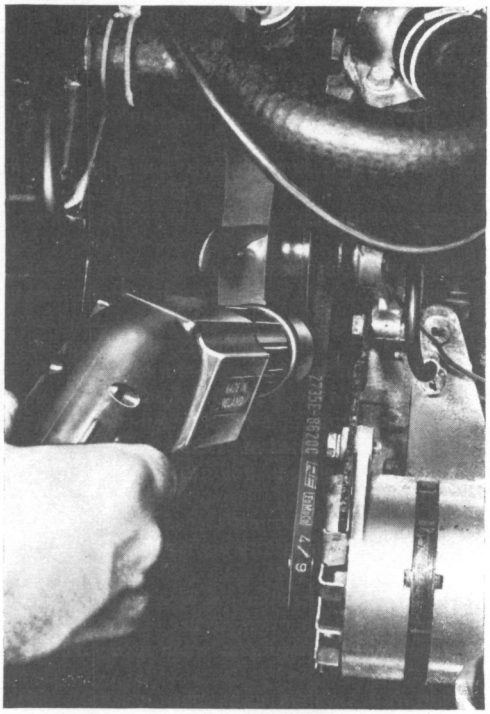


Fig. C:9 Checking timing with strobe light

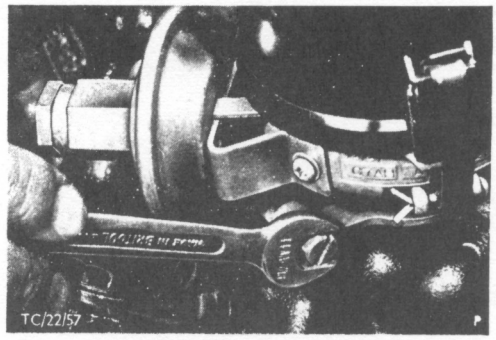


Fig. C:10 Distributor clamp plate - OHV

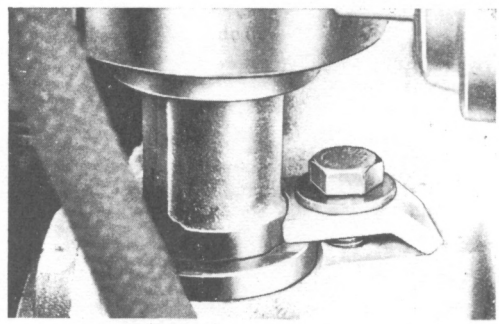


Fig. C:11 Distributor clamp plate - OHC

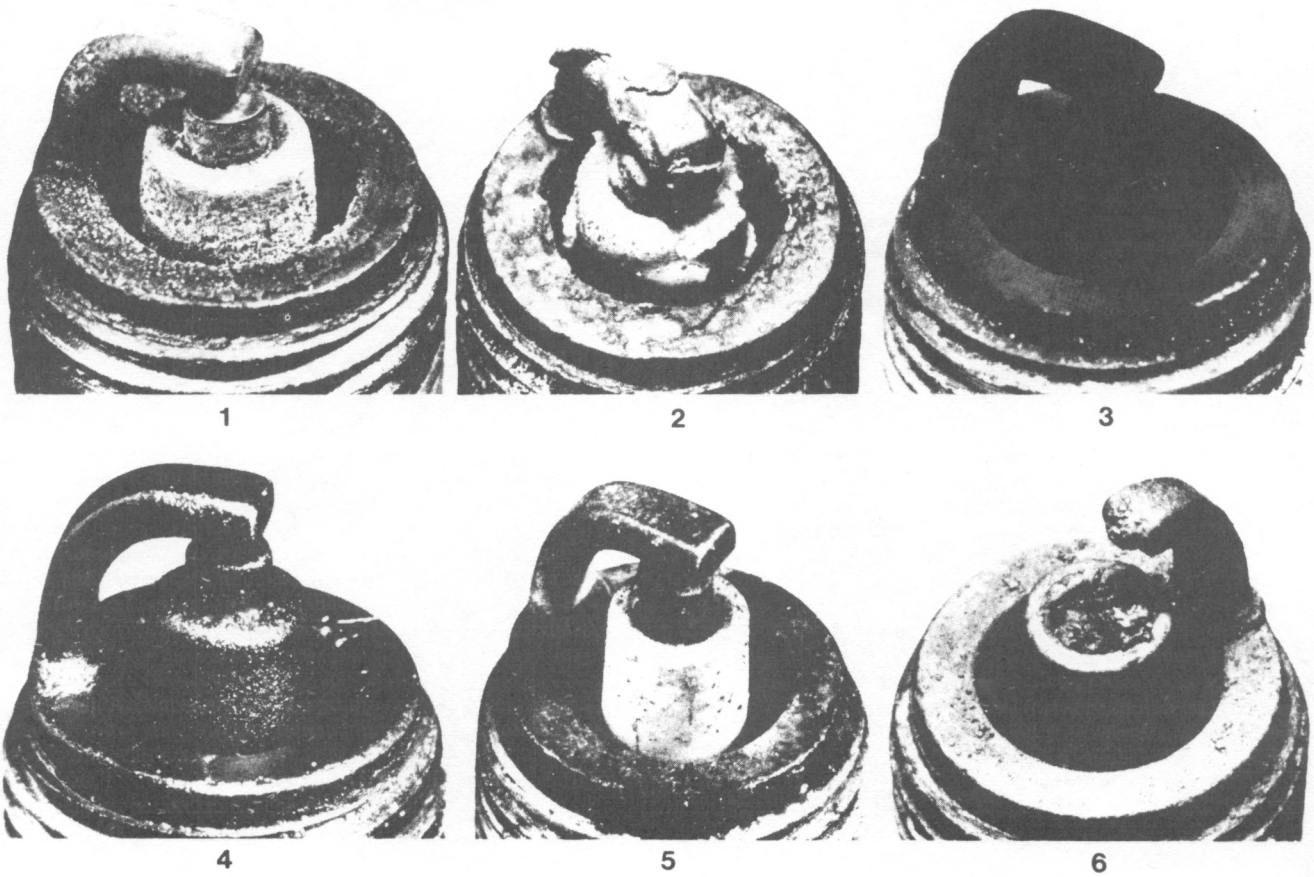


Fig. C:12 Sparking plug conditions

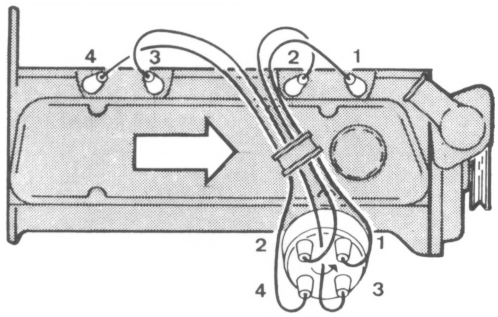


Fig. C:13 Spark plug lead numbering - OHV

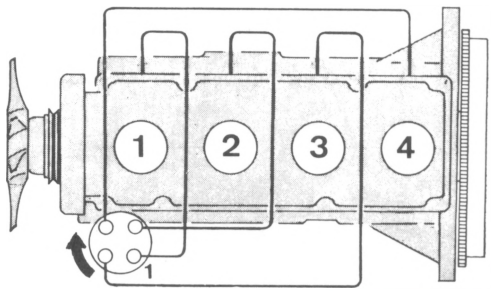
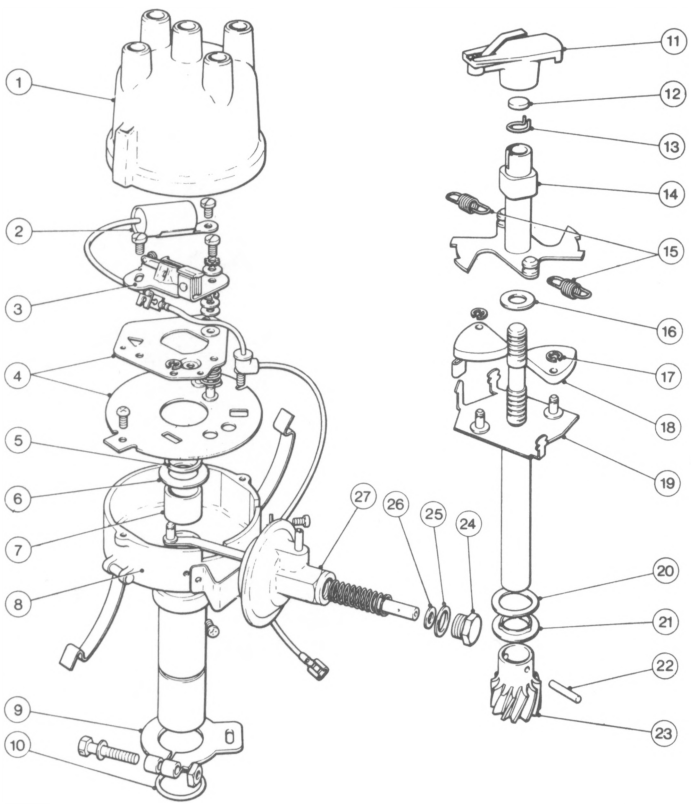


Fig. C:14 Spark plug lead numbering - OHC



1. *Distributor cap*
2. *Condenser*
3. *Points assembly*
4. *Breaker plate assembly*
5. *Thrust washer*
6. *Thrust washer*
7. *Bush*
8. *Body*
9. *Clamp plate*
10. *Sealing ring*
11. *Rotor arm*
12. *Felt pad*
13. *Circlip*
14. *Cam assembly*
15. *Advance springs*
16. *Washer*
17. *Circlip*
18. *Governor weights*
19. *Shaft and action plate*
20. *Spacer*
21. *Thrust washer*
22. *Retaining pin*
23. *Skew gear*
24. *Plug*
25. *Sealing ring*
26. *Shim*
27. *Vacuum unit*

Fig. C:15 Exploded view of distributor

cleaned reasonably well by using a wire brush which is held tightly in a vice. Rub plug ends briskly along the wire brush until a shining surface is evident.

Set the plug gaps using the appropriate value feeler gauge and bending tool.

NOTE: When setting plug gaps the centre electrode must never be bent as this may crack the insulation and cause plug failure.

Replace

1. Re-fit plugs and leads in the reverse order of removal. Don't overtighten.
2. Tighten by hand and then further tighten ½ of a turn with a spanner.

DISTRIBUTOR - Cap

1. Clean the distributor cap, using a soft bristle brush and mild cleaning solvent or mineral spirits. Dry with compressed air.
2. Inspect the cap for cracks, burnt contacts, permanent carbon tracks or dirt or corrosion in the sockets. Replace the cap if any of these conditions are present.

High Tension Leads

3. Wipe the wires with a damp cloth, and check for fraying, breaks, or cracked insulation. Inspect the terminals and weather seals for looseness or corrosion. If any of the leads are not in good condition, it is recommended that the leads be replaced as a complete set. The leads are of the suppressor type; ensure that replacements are the same.

The correct routing of the high tension leads is shown in Figs. C:13 and C:14.

Rotor Arm

4. Clean the rotor arm, using a soft bristle brush and mild cleaning solvent or mineral spirits. Dry with compressed air. Inspect the rotor for cracks or burning. The outer face of the rotor contact can be cleaned by rubbing it on the side wall of a tyre. Replace the rotor if defective in any way.

DISTRIBUTOR - Removal

1. Disconnect the distributor from tension lead at the ignition coil.
2. Disconnect the vacuum line at the distributor.
3. Remove the distributor cap.
4. Remove the bolt securing the distributor cylinder block, and withdraw the distributor.

Installation

1. Turn the crankshaft until No. 1 piston is coming up to T.D.C. on the compression stroke. This can be determined by removing the spark plug from No. 1 cylinder, and feeling the pressure developed at the spark plug hole.
2. Continue turning the crankshaft until the appropriate timing marks on the crankshaft pulley and timing gear cover are aligned (Figs. C:7 and C:8)
3. Temporarily refit the distributor cap, mark the position of the No. 1 spark lead on the distributor body, then remove the cap.
4. On O.H.V. engines, position the distributor on the engine with the vacuum unit at approximately right-angles to the the crankshaft centre-line, and the rotor arm held at 35^{o} - 40^{o} anti-clockwise of the mark made on the distributor body.
5. Insert the distributor into the block. As the gears mesh, the rotor should rotate in a clockwise direction until it adopts its correct position in line with the mark.
6. On O.H.C. engines, position the distributor on the engine, with the vacuum unit facing to the rear, and the rotor arm held at 35^{o} - 40^{o} clockwise of the mark made on the distributor body.
7. Insert the distributor into the block. As the gears mesh, the rotor should rotate in an anti-clockwise direction until it adopts its correct position in line with the mark.
8. Secure the distributor to the cylinder block with the clamp retaining bolt. On OHV engines, if the hole in the clamp does not align with the corresponding hole in the cylinder block, slacken the clamp bolt, and reposition the clamp on the distributor body WITHOUT turning the distributor, then tighten the clamp bolt (Fig. C:10).
9. Connect the distributor low tension lead to the ignition coil.
10. Refit the distributor cap.
11. Check the ignition timing, as described previously, then reconnect the vacuum line.

Overhaul

In most cases of wear or damage to the components of the distributor, especially after considerable mileage, it will be found more economical and convenient to exchange the complete distributor for a new or reconditioned unit.

The condition of the various components should be checked, as described below:-

Distributor body: Check for cracks or other damage.

Breaker plate: Check for distortion, inspect the stationary sub-plate for worn nylon contact buttons.

Shaft: Check for excessive side play or end-float, indicating worn bushings.

Cam: Inspect for scoring or signs of wear.

Advance springs: Check for weakness, by holding the rotor arm and rotating the shaft drive gear. The breaker plate assembly should return to its original position without sticking, when released.

Vacuum unit: Check for signs of leakage or damage. Also check the housing bracket unit pull rod.

Vacuum line: Check for leaks, cracks or other damage.

The components of the distributor are shown in Fig. C:15.

Technical Data

DISTRIBUTOR APPLICATION

1300 cc OHV	LC	71-BB-12100-AKA (Red and Green)
	HC	71-BB-12100-AMA (Red and Black)
1600 cc OHV	LC	71-BB-12100-ANA (Red and White)
	HC	71-BB-12100-AMA (Red and Black)
1600 cc OHC	LC	72-BB-12100-AA/Ba
	HC	72-BB-12100-AB/BB
1600 cc OHC	GT	71-BB-12100-UB
	Auto.	73-BB-12100-AA
2000 cc OHC	HC	71-BB-12100-UB
	Auto.	71-BB-12100-UC

Firing Order

	OHV	1 - 2 - 4 - 3
	OHC	1 - 3 - 4 - 2

Points gap

	OHV	6,4 mm (0.025 in)
	OHC	0,56 - 0,71 mm (0.022 - 0.028)

Dwell angle

	OHV	38 - 40°
1600 OHC Man.	LC	38 - 40°
	HC	48 - 52°
2000 Man	HC	38 - 40°
	Auto.	48 - 52°

DISTRIBUTOR

Rotation OHV	Anti-clockwise from above
OHC	Clockwise from above

Ignition timing (static):

1600 cc OHV/OHC	6° B.T.D.C.
1600 GT OHC/MAN.	4° B.T.D.C.
OHC/Auto.	8° B.T.D.C.
2000 cc OHC/MAN	4° B.T.D.C.
OHC/AUTO	4° B.T.D.C.
Condenser capacity	0,21 - 0,25 mfd
Ignition coil	
Ballast resistor	1.5 ohms
Primary	0,95 - 1,02 ohms
Secondary	5,900 - 6,900 ohms

SPARKING PLUGS

All OHV	AGR 22
1600 OHC LC	BF 32
HC	BF 32
1600 GT HC	BF 32
2000 HC	BF 32
Electrode gap	0,64 mm (0.025 in)

FUEL GRADE

1300 cc	LC	91 Octane (2 Star)
	HC	97 Octane (4 Star)
1600 cc	LC	91 Octane (2 Star)
	HC	97 Octane (4 Star)
1600 GT	HC	97 Octane (4 Star)
2000	HC	97 Octane (4 Star)

Fuel System

GENERAL
AIR CLEANER
IN-LINE FUEL FILTER
FUEL PUMP
ACCELERATOR LINKAGE
FORD CARBURETTOR
WEBER CARBURETTOR
TECHNICAL DATA

GENERAL

Two types of carburettor are used: both OHV and 1600 OHC models are equipped with A Ford single-barrel down-draught carburettor. On later 1300cc OHV and 1600cc OHC models a Motorcraft 'increased severity' carburettor is fitted which incorporates a 'by-pass' idle system. It is visually similar to the earlier Motorcraft carburettor but can be identified by comparing the number of screws retaining the upper body. The new unit has seven screws, the earlier model six. Servicing procedure is identical to the earlier Motorcraft carburettor.

1600 GT and 2000 OHC vehicles have a Weber dual-barrel down-draught carburettor. On later 1600 and 2000cc OHC models a Weber 'by-pass'carburettor is fitted. Features of which are two independent idling systems. These systems are referred to as 'by-pass' idle and 'basic' idle. It is not necessary to service the 'basic' system at regular intervals - only when overhaul of the carburettor has been completed, or if correct idle cannot be achieved using the 'by-pass' adjuster.

The new carburettor can be easily identified by a plastic cap which is fitted to the 'basic' idle screw.

Also fitted to the later models is a fuel return flow line incorporated into the Weber carburettor and linked to the fuel tank. Identification is by cast housing on top of the carburettor at the supply pipe. Flow is indicated by two arrows and one outlet is blanked off.

The Ford carburettor has the following systems: an idling, main, power valve and diaphragm-type accelerator pump system. Cold starting is by a semi-automatic strangler type choke, or on 1600 auto. trans. models, a fully automatic choke. The float chamber is internally vented. Carburettor identification is stamped on the float chamber.

The carburettor is comprised of two main castings which form the upper and lower bodies. The upper body incorporates fuel inlet, needle valve and float, the air intake and choke plate, the complete main and power valve system and discharge beak, the idling jet and first idle air bleed or the idling system, and the accelerator pump discharge nozzle.

On models with automatic choke, the choke assembly is attached to the upper body and consists of an inner and outer housing incorporating a water housing, a thermostatic spring and lever, a vacuum piston and lever, and a choke control lever and shaft.

The lower body incorporates the float chamber, the throttle barrel, throttle plate, spindle and lever. The idling discharge orifice, progression slot and adjustment screws, the accelerator pump, the choke linkage, and the distributor vacuum connection.

The Weber carburettor incorporates an idling, main, full-load enrichment, power valve and diaphragm-type accelerator pump system. Cold starting is by a fully-automatic choke. The float chamber is internally vented. Carburettor indentification is stamped on the carburettor mounting flange.

The carburettor comprises two main casting which form the upper and lower bodies. The upper body incorporates the fuel inlet, needle valve and float, the twin air intakes and choke plates, and the vacuum-controlled section of the power valve.

The lower body incorporates the float chamber, the two throttle barrels, throttle plates, spindles, and levers, the accelerator pump. The fuel power valve, all the jets, the idle adjustment screws, and the distributor vacuum connection. The choke assembly consisting of an inner and outer housing incorporating a water housing, a thermostatic spring and lever, a vacuum piston and lever, and a choke control lever and shaft.

Throttle plate opening is progressive, the primary plate starting to open first, followed by the secondary, both plates reaching the fully-open position simultaneously. The primary barrel, venturi and throttle plate is smaller than that of the secondary, whilst the auxiliary venturi size is identical for both the primary and secondary. All the carburettor systems are incorporated in the lower body. The main progression systems operate in both barrels, the idling and the power valve systems in the primary barrel only, and the full-load enrichment in the secondary barrel. The accelerator pump discharges into the primary barrel.

Four types of fuel pump are used; two types on the OHV engines (1300 & 1600), and two types on the OHC engines (1600/GT & 2000). In each case, the pump is of the mechanical, diaphragm-type, and incorporates a filter screen and sediment cap. All types are identified in Fig. D:4 - D:7.

On the OHV engine, the fuel pump is mounted on the R.H. side of the engine, and is driven by an eccentric on the camshaft. On OHC engines, the pump is mounted on the L.H. side of the cylinder block, and is driven by the auxiliary shaft through a short push rod.

A separate in-line fuel filter is incorporated between the pump and the carburettor to provide additional filtration. The filter is a one-piece assembly and must be replaced if clogged or restricted.

The fuel tank is located below the luggage compartment, and is secured with two straps. Fuel tank ventilation is via the filler cap. The fuel outlet is incorporated in the fuel gauge sender unit, in the front face of the tank.

AIR CLEANER (Fig. D:1 and D:2)

The air cleaner contains a replaceable paper element. It is important that the air cleaner be serviced periodically, as a dirty element will restrict the air flow to the carburettor in-take, causing an over-richening of the fuel mixture, with a subsequent increase in fuel consumption.

1. Detach the top cover, and lift out the filter element Wipe out the inside of the cleaner body with a petrol-moistened rag. The element can be cleaned, by holding it vertically, and tapping it LIGHTLY to dislodge the dirt and dust. Rotate the element after each tap until the entire outer surface has been cleaned.
2. An alternative method of cleaning the element is to blow a stream of low-pressure compressed air through the element in the reverse direction to the normal air flow. Extreme care must be taken to avoid rupturing the element material.

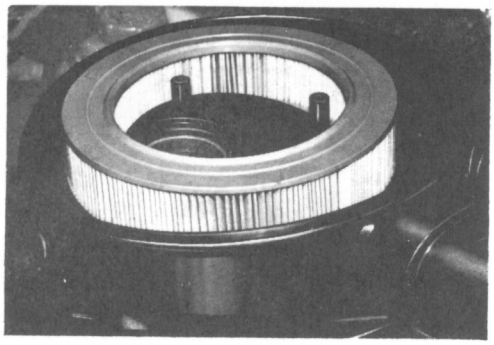


Fig. D:1 Air cleaner - Ford carburettor

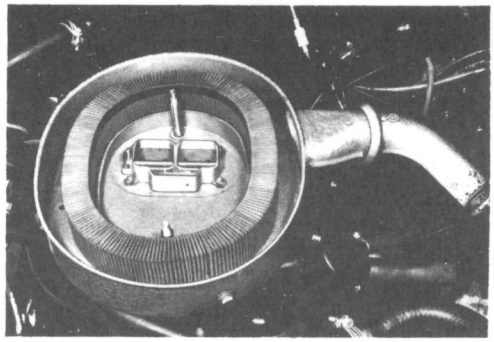


Fig. D:2 Air cleaner - Weber carburettor

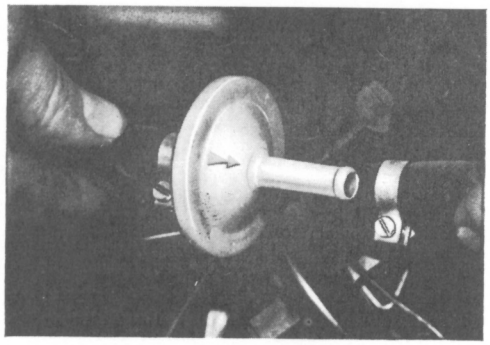


Fig. D:3 In-line fuel filter

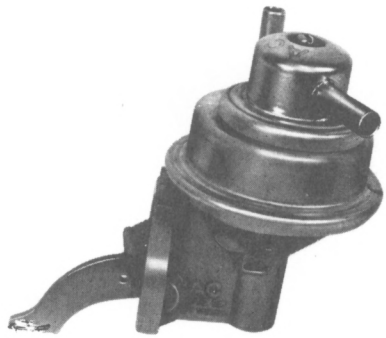


Fig. D:4 Fuel pump normally fitted to OHV engines

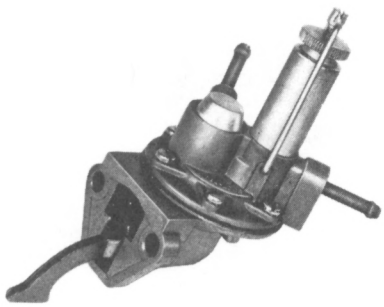


Fig. D:5 Alternative fuel pump for OHV engines

Fig. D:6 Fuel pump normally fitted to OHC engines

Fig. D:7 Alternative fuel pump for OHC engines

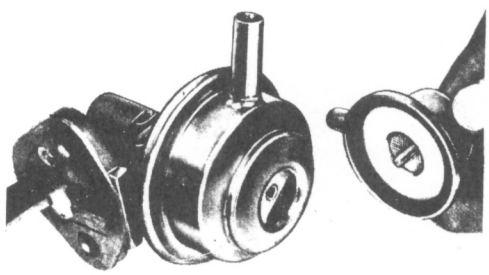


Fig. D:8 Remove pump sediment cap and filter screen - normal type

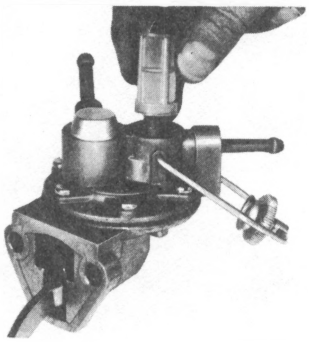


Fig. D:9 Removing filter screen alternative type

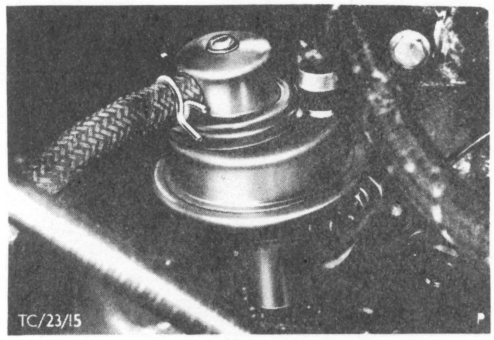


Fig. D:10 Pump installation - OHV engines

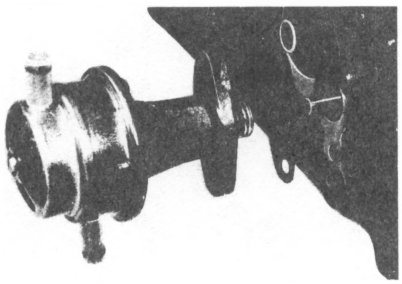


Fig. D:11 Pump installation - OHC engines

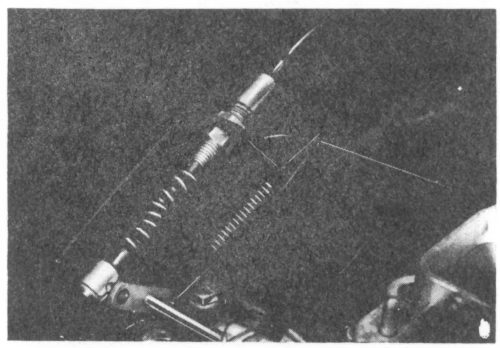


Fig. D:12 Accelerator linkage adjustment

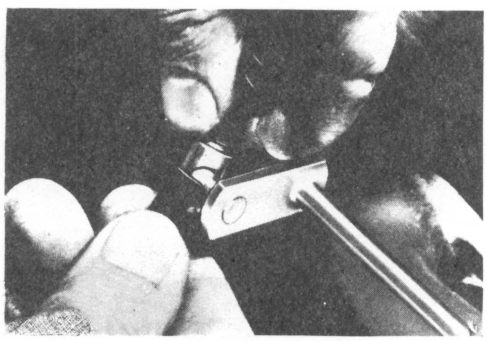


Fig. D:13 Accelerator cable connection at throttle shaft lever

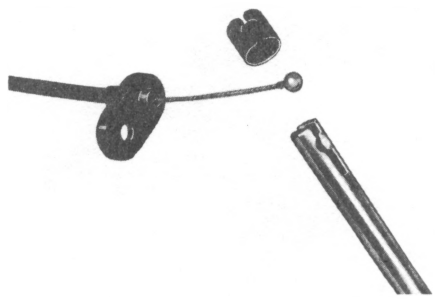


Fig. D:14 Accelerator cable connection at accelerator pedal shaft

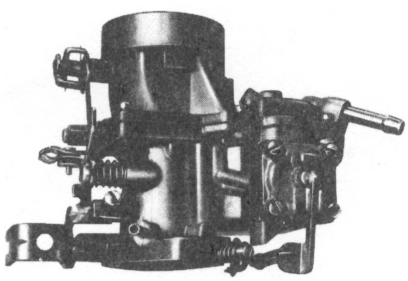


Fig. D:15 Ford carburettor - manual choke

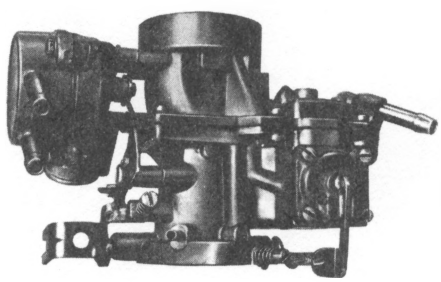


Fig. D:16 Ford carburettor - automatic choke

NOTE: Under NO circumstances should the element be washed with solvent or cleaning solution. If excessively dirty, split or torn the element must be renewed.

3. Inspect the element sealing gasket, and replace if worn or damaged. Ensure that the element is properly seated in the cleaner body and install the cover.

On some vehicles, the air cleaner spout may be swivelled towards the exhaust pipe to ensure a supply of warm air to the engine during cold weather. Turn the end of the spout until the 'W' (Winter) or 'S' (Summer) aligns with the arrow on the fixed portion.

IN-LINE FUEL FILTER (Fig. D:3)

The in-line fuel filter is fitted in the fuel line between the carburettor and fuel pump.

1. To remove the filter, slacken the hose clamps, and disconnect the fuel hoses from each side of the filter. Blow through the filter in the reverse direction of the fuel flow, indicated by the arrow on the filter housing.

The filter is not otherwise serviceable, and must therefore be replaced if clogged or restricted.

2. Ensure that the arrow points in the direction of the fuel flow when refitting the filter. Tighten the hose clamps securely.

FUEL PUMP - Cleaning (Figs. D:4 - D:9)

1. Remove the centre-screw or 'O' ring, or unscrew the knurled nut as applicable, and lift off the sediment cap, filter screen, and sealing ring.
2. Blow the cap and filter screen clean, or wash them in petrol. Inspect the sealing ring, and renew if perished or worn, or otherwise damaged.
3. Carefully refit the filter screen, sealing ring, and sediment cap, and secure with the knurled nut, or centre-screw and 'O' ring as applicable.

Delivery Pressure Check

1. Fill the carburettor float chamber with petrol. If necessary a separate gravity feed fuel supply can be connected to the carburettor.
2. Disconnect the fuel line between the fuel pump and carburettor, and connect a pressure gauge to the pump outlet.
3. Start the engine, and observe the pressure reading with the engine running at idling speed. Momentarily race the engine, and check that the pressure indicated is as specified.
4. Stop the engine, disconnect the pressure gauge, and reconnect the fuel line.

Removal

1. Disconnect the fuel supply and delivery pipes at the fuel pump. Plug the pipe ends to prevent loss of fuel and the ingress of dirt.
2. Remove the two retaining bolts and detach the pump from the cylinder block. On OHV engines, also remove the insulating block fitted between the pump and cylinder block. On OHC engines, remove the gasket and withdraw the pump push rod.

Installation

1. Clean all old gasket material from the mating faces of the pump and mounting pad.
2. On OHC engines, insert the pump push rod into its guide bore in the cylinder block (Fig. D:11). Fit the pump, using a new gasket, or spacer, as applicable.
3. On OHV engines, ensure that the pump operating arm lies on the camshaft eccentric (Fig. D:10). Secure with the two retaining bolts, then reconnect the fuel pipes. Start the engine and check for fuel leaks.

Overhaul

NOTE: In most cases it will probably be more economical and convenient to exchange a defective fuel pump for a new or reconditioned unit, especially after considerable mileage.

Dismantling

1. Mark the relative positions of the upper and lower pump body to ensure correct alignment during reassembly.
2. Remove the retaining screws and separate the bodies. Take care to avoid damaging the diaphragm.
3. Relieve the staking securing the pump operating arm pivot pin, and tap the pin out of the lower body, using a pin punch.
4. Press the diaphragm into the pump body, and pull the operating arm outwards to disengage it from the diaphragm stem. Lift out the diaphragm and lower seal.

Reassembly

1. Install the new oil seal in the lower body. Lubricate the diaphragm stem, and position the diaphragm assembly in the pump body.
2. Hold the lower body upright, press down on the diaphragm and engage the pump operating arm on the diaphragm stem.
3. Position the operating arm, and insert the pivot pin through the pump body and arm. The arm must be located with the cam shoe facing away from the diaphragm.
4. Secure the pin by staking. Push in the operating arm until the diaphragm is level with the flange, then fit the upper body with the scribed marks aligned.
5. Tighten the securing screws finger-tight, operate the arm for several strokes to centralise the diaphragm, then tighten the screws evenly with the diaphragm in its "down" position.

ACCELERATOR LINKAGE - Adjustment (Fig. D:12)

1. Slacken the two outer cable locknuts at the abutment bracket.
2. Detach the throttle return spring. Depress the throttle pedal and hold it in the full-throttle position.
3. With the carburettor throttle plate in the fully-open position, adjust the nut nearest the outer cable until all slackness is removed from the inner cable and the throttle plate is just maintained in the fully open position.
4. Tighten the other nut to secure the cable, and check the setting. Release the throttle pedal, and refit the throttle return spring. Check the operation of the throttle linkage.

Replacement

1. Disconnect the inner cable from the throttle shaft lever, by sliding the spring clip off the joint and pulling the cable socket off the lever ball (Fig. D:13).
2. Slacken the two outer cable locknuts at the abutment bracket, screw the nut off the end of the threaded sleeve, and disconnect the cable from the bracket.
3. Remove the spring clip, and disconnect the inner cable from the lever on the accelerator pedal shaft (Fig. D:14).
4. Remove the screw securing the outer cable flange to

1. *Choke shaft*
2. *Choke plate*
3. *Upper body*
4. *External vent (not applicable)*
5. *Fuel inlet*
6. *Fuel filter*
7. *Needle valve housing*
8. *Main jet*
9. *Needle valve*
10. *Fuel float*
11. *Gasket*
12. *Lower body*
13. *Weight*
14. *Ball valve*
15. *Diaphragm*
16. *Accelerator pump cover*
17. *Pump operating rod*
18. *Volume control screw*
19. *Throttle stop screw*
20. *Throttle plate*
21. *Throttle shaft*
22. *Fast idle cam*
23. *Choke operating link*

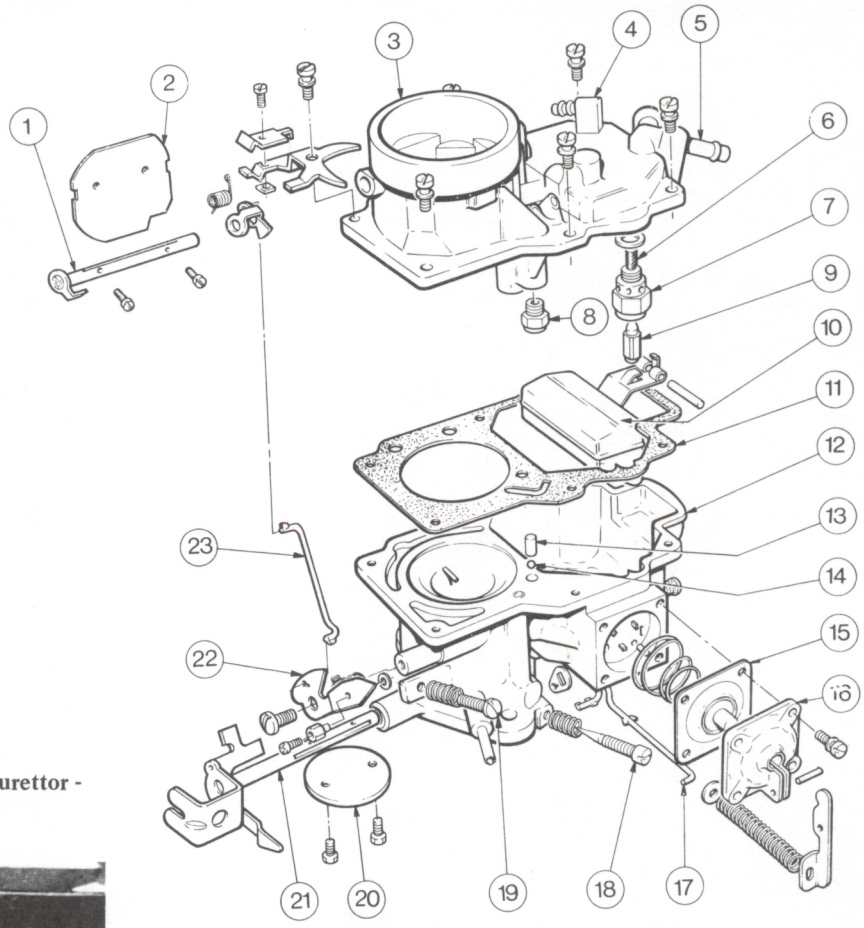


Fig. D:17 Exploded view of Ford carburettor - manual choke

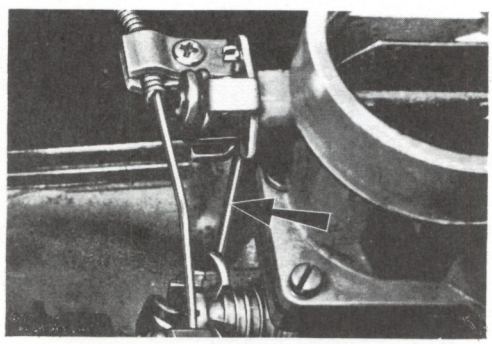


Fig. D:18 Removing carburettor upper body - Ford manual choke

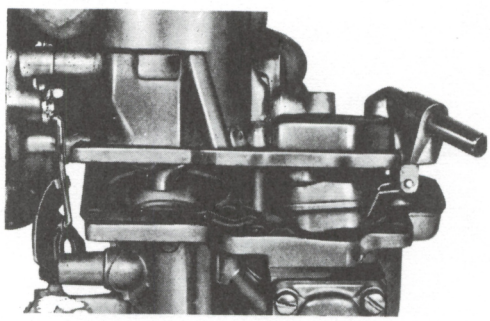


Fig. D:19 Removing carburettor upper body - Ford automatic choke

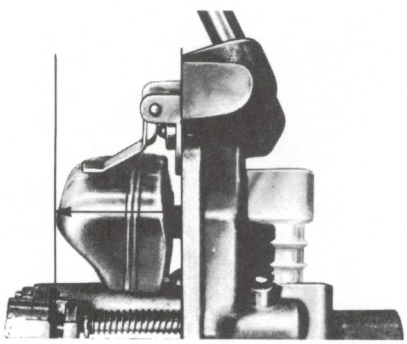


Fig. D:20 Float level setting - Ford

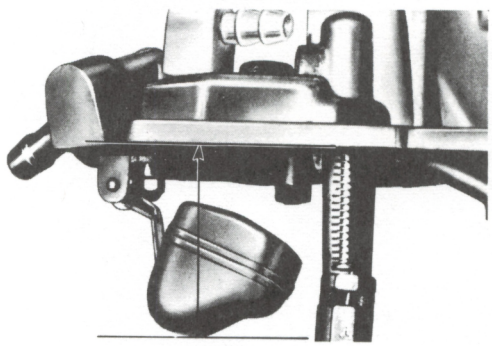


Fig. D:21 Float travel setting - Ford

1. *Thermostatic spring and water housing*
2. *Thermostatic spring*
3. *Choke shaft*
4. *Choke plate*
5. *Vacuum port gasket*
6. *Upper body*
7. *External vent (not applicable)*
8. *Fuel inlet*
9. *Fuel filter*
10. *Needle valve housing*
11. *Main jet*
12. *Needle valve*
13. *Fuel float*
14. *Gasket*
15. *Lower body*
16. *Accelerator pump cover*
17. *Diaphragm*
18. *Pump operating rod*
19. *Volume control screw*
20. *Throttle stop screw*
21. *Throttle plate*
22. *Throttle shaft*
23. *Fast idle cam*
24. *Ball valve*
25. *Weight*
26. *Automatic choke housing*
27. *Spring engagement lever*

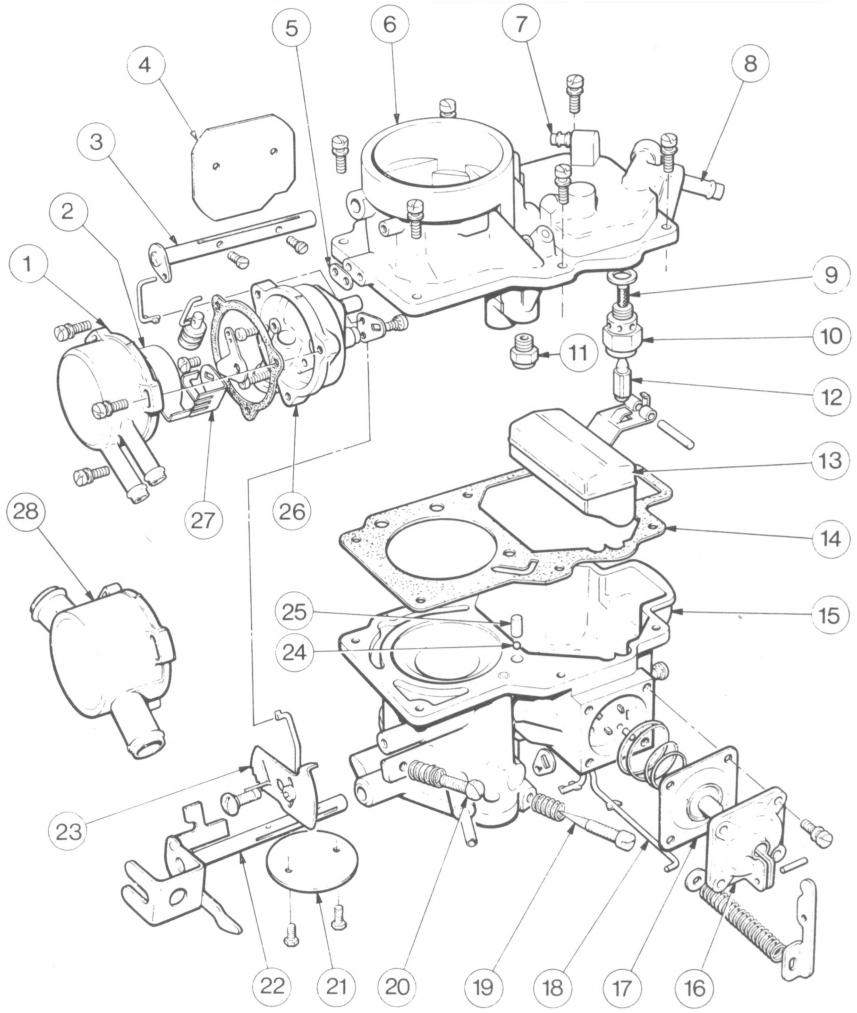


Fig. D:22 Exploded view of Ford carburettor - automatic choke

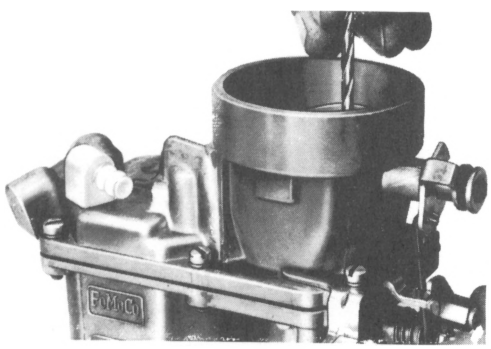


Fig. D:23 Checking choke plate pull-down setting - Ford manual choke

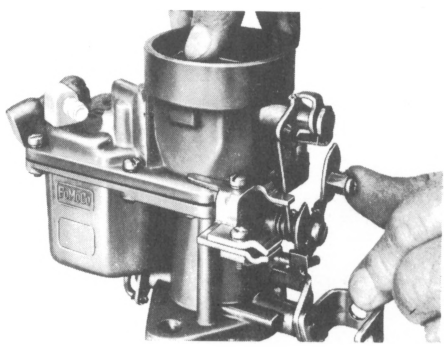


Fig. D:24 Checking fast idle setting - Ford manual choke

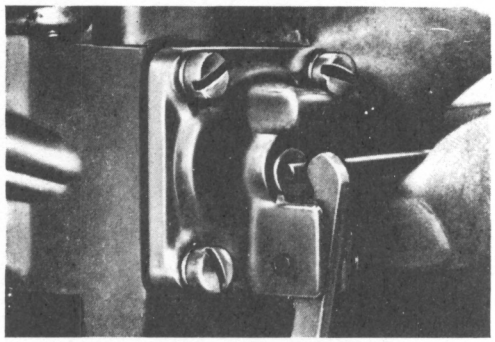


Fig. D:25 Checking accelerator pump stroke - Ford

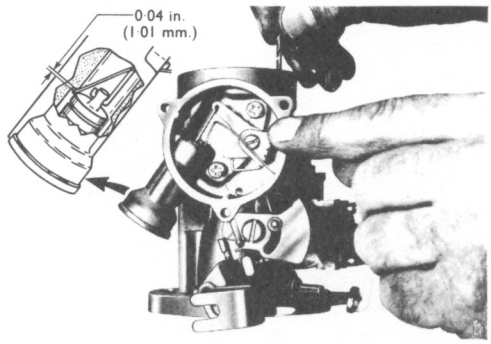


Fig. D:26 Checking choke plate pull-down setting - Ford, automatic choke

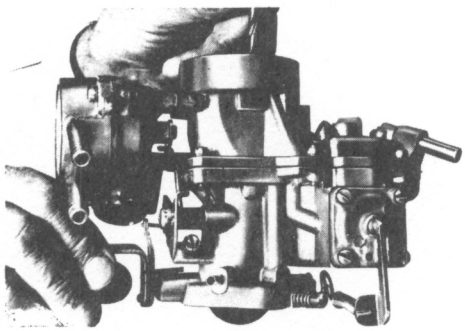


Fig. D:27 Checking de-choke setting - Ford automatic choke

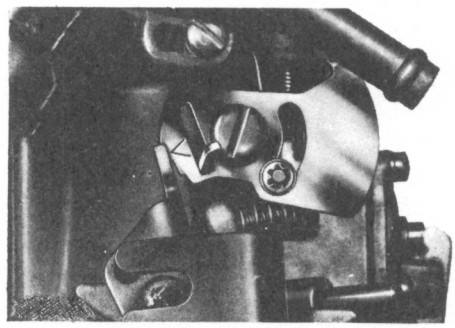


Fig. D:28 Fast idle setting - Ford automatic choke

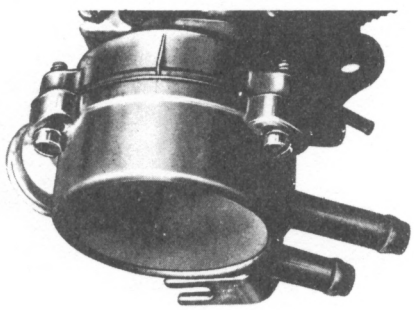


Fig. D:29 Choke housing alignment marks - Ford, automatic choke

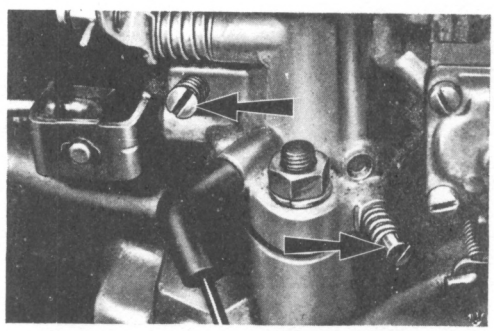


Fig. D:30 Slow running adjustment screws - Ford

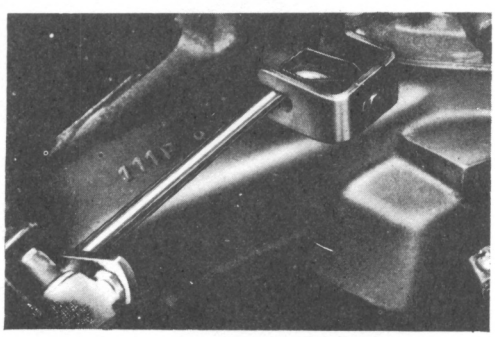


Fig. D:31 Throttle control shaft - Ford

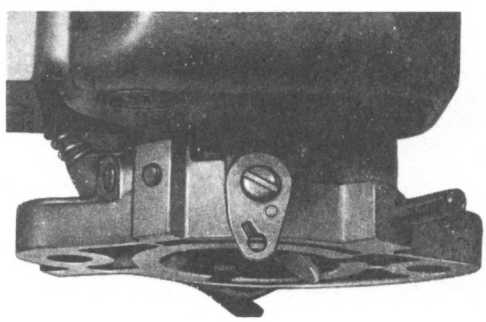


Fig. D:32 Throttle shaft plate installation - Ford

the engine compartment bulkhead, and withdraw the cable.

Install the new throttle cable in the reverse order of removal. Adjust the cable, as described above.

Cleaning

Periodically, the carburettor float chamber should be cleaned out.

1. Remove the air cleaner, disconnect the fuel pipe, and remove the carburettor upper body.
2. Clean the float chamber with petrol to remove any sediment, etc. Remove all jets, then blow out the jets and passages.
3. Clean the gauge filter, located beneath the fuel inlet connection. Refit the jets, carburettor upper body, fuel pipe and air cleaner. Clean out fuel pump filter, in-line filter and fuel lines at the same time.

CARBURETTOR - Adjustments

Float Level and Travel

1. Remove the air cleaner, and disconnect the fuel line. On automatic choke models, partially drain the cooling system and disconnect the choke hoses at the carburettor. Remove the pivot screw retaining the fast idle cam and link rod to the lower body.
2. Remove the upper body retaining screws and lift off the upper body, simultaneously disengaging the choke link from the fast idle cam (manual choke models Fig. D:18). Note that the manual choke cable bracket is also retained by the rear left-hand cover screw.

NOTE: Once the upper body is removed, the accelerator pump discharge valve will be exposed in its bore in the top face. Care should be taken when operating the throttle linkage, otherwise the valve and weight may be ejected. This would cause serious damage if the valve enters the engine.

3. Hold the upper body in the vertical position with the float hanging down, as shown in Fig. D:20, and measure the distance from the upper body face to the bottom of the float with a depth gauge or similar instrument.
4. If the float level is outside specification, adjust by bending the tab resting against the needle valve.
5. Turn the upper body upright, as shown in Fig. D:21, and again measure the distance from the body face to the bottom of the float. If the float travel is outside specification, adjust by bending the tab resting against the needle valve housing.
6. Refit the upper body while holding the manual choke lever in the closed position, and simultaneously connect the choke link to the fast idle cam. Position the choke cable bracket beneath the rear L.H. screw.

NOTE: Failure to hold the choke lever in the closed position will result in the choke lever being over-centred, and the choke will be rendered inoperative. If this occurs, do NOT force the lever back to its correct position. Release the cover retaining screw, move the lever to the closed position, and then retighten.

7. On models with automatic choke, position the fast idle cam and link rod on the lower body and secure with the shouldered pivot screw. Reconnect the fuel line. Where applicable, reconnect the automatic choke hoses, and top up the cooling system.

Choke Plate Pull-Down (Manual Choke (Fig. D:23)

1. Rotate the choke lever to its stop, and depress the choke plate.
2. Using a drill or gauge rod of appropriate diameter, check that the specified clearance exists between the lower edge of the choke plate and the wall of the air intake.
3. If adjustment is necessary, bend the tab on the choke spindle to obtain the correct setting.

Fast Idle (Manual Choke) (Fig. D.24)

1. Connect a tachometer to the engine and run the gauge up to normal operating temperature.
2. With the engine running at its specified idling speed, hold the choke plate vertically, in the fully-open position, and rotate the choke lever until it is stopped by the choke linkage. Note the engine speed indicated on the tachometer.
3. If outside the specified fast idle speed, adjust by bending the tab connecting the fast idle cam

Accelerator Pump Stroke (Fig. D:25).

1. Unscrew the throttle stop screw several turns, until the throttle plate is closed.
2. Depress the diaphragm plunger on the accelerator pump, then, using a drill or gauge rod of appropriate diameter, check that the specified clearance exists between the plunger and the pump operating lever. If necessary, bend the goose-neck on the pump push-rod to adjust pump stroke.
3. Close the loop to lengthen the stroke, or expand it to shorten the stroke. Reset the throttle stop screw to its original position.

Choke Plate Pull-Down (Auto. Choke (Fig. D:26).

1. Remove the water housing and thermostatic spring from the automatic choke assembly.
2. Depress the vacuum piston until the vacuum port in the piston bore is revealed, then insert a length of 1.01 mm (0.040 in) diameter wire, suitably bent, into the port and raise the piston to trap the wire.
3. With the piston and wire held in this position and wire held in this position, close the choke plate until its movement is stopped through the linkage partially open the throttle for the fast idle tab to clear the cam.
4. Using a drill or gauge rod of appropriate diameter, check that the specified gap exists between the lower edge of the choke plate and the wall of the air intake. If necessary, adjust by bending the extension of the choke thermostat lever (i.e. the part which abuts the piston operating lever).

De-Choke (Auto. Choke) (Fig. D:27)

1. Close the choke plate, using the spring operated lever, then open the throttle fully and hold it against its stop.
2. Using a drill or gauge rod of appropriate diameter, check that the clearance between the lower edge of the choke plate and the wall of the air intake is as specified. Adjust, if necessary, by bending the projection on the fast idle cam.

Fast Idle (Auto. Choke) (Fig. D:28)

1. With the choke plate pull-down correctly set, hold the choke plate in the pull-down position.
2. Check that the throttle lever fast idle tab is in the first or high speed step on the fast idle cam (arrowed on cam).
3. If necessary, bend the fast idle rod at its existing bend to achieve this result.
4. Fit the thermostatic spring and water housing to the choke assembly, ensuring the spring engages in the centre slot of the thermostatic lever (Fig. D:38).
5. Align the mating marks on the housing, then secure with the retaining screws (Fig. D:29). Reconnect the choke water hoses, if disconnected, then refill the cooling system.

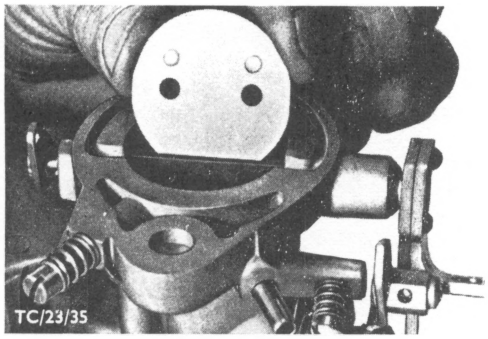


Fig. D:33 Throttle plate installation - Ford

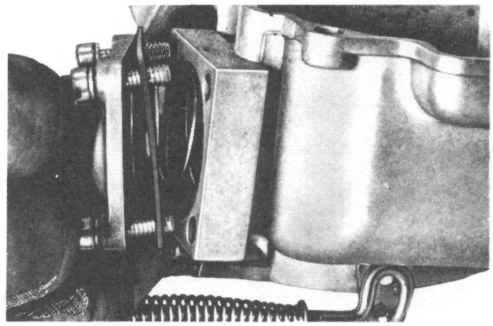


Fig. D:34 Accelerator pump installation - Ford

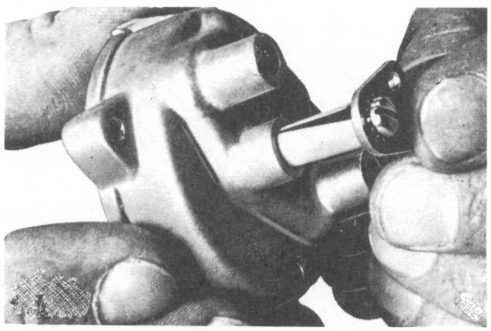


Fig. D:35 Assembling automatic choke - Ford

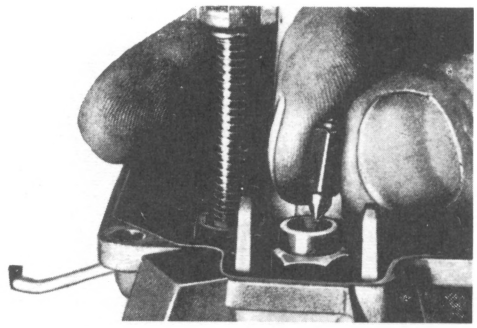


Fig. D:36 Replacing fuel needle valve - Ford

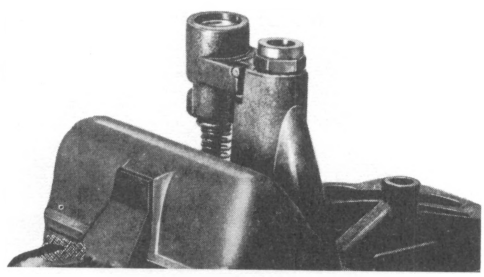


Fig. D:37 Main jet location

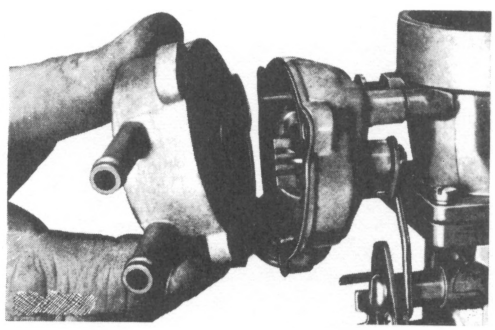


Fig. D:38 Fitting thermostatic spring housing - Ford, automatic choke

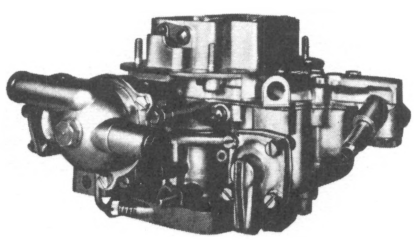


Fig. D: 39 Weber carburettor

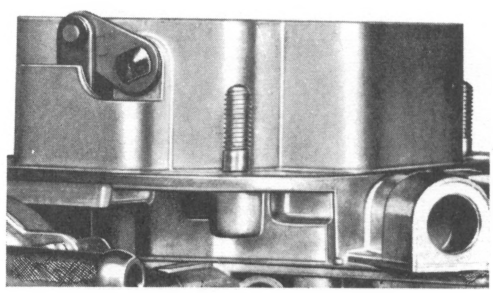


Fig. D: 40 Choke plate operating link connection - Weber

6. Connect a tachometer to the engine, and run the engine up to normal operating temperature. Position the throttle lever fast idle tab on the first step of the fast idle cam (Fig. D:28), and check the engine speed. If outside the specified fast idle speed adjust by bending the tab contacting the fast idle cam.

Slow Running (Fig. D:30)

The carburettor slow running adjustment should preferably be set with the aid of a vacuum gauge or an E.G.A. (exhaust gas analyser), but can be set without these instruments. However, in each case, the crankcase ventilation system regulator valve must be connected to the inlet manifold while carrying out the adjustment.

NOTE: On vehicles with automatic transmission, select the 'P' or 'N' range, and fully apply the handbrake when carrying out this adjustment.

Without Instruments

1. With the engine at normal operating temperature, adjust the throttle stop screw to obtain satisfactory idling speed. Unscrew the volume control screw until the engine begins to "hunt" (i.e. run irregularly or lumpily), then screw it in again until the engine runs evenly. Re-adjust the throttle stop screw to obtain suitable engine idle speed. Repeat the operation if necessary, until a satisfactory idle is obtained.

Using a Vacuum Gauge

2. Connect the vacuum gauge into the crankcase ventilation tube, as close to the carburettor as possible, using a suitable 'T' connector. Connect a tachometer to the engine, and run the engine up to normal operating temperature. Adjust the throttle stop screw until the specified idle speed is obtained. Adjust the volume control screw to obtain maximum vacuum reading, re-adjusting the idle speed as necessary. Remove the vacuum gauge and tachometer, and reconnect the crankcase ventilation tube.

Using an Exhaust Gas Analyser

3. Connect the E.G.A. in accordance with the instrument manufacturers instructions, and adjust the volume control screw to give the optimum mixture strength.

CARBURETTOR - Removal and Installation

1. Remove the air cleaner. Disconnect the fuel supply and distributor vacuum pipes at the carburettor.
2. Release the spring clip and disconnect the throttle control shaft from the carburettor throttle shaft (Fig. D:31).
3. On manual choke models, partially drain the cooling system, and disconnect the water hoses at the choke housing. Remove the two retaining nuts and spring washers, and lift the carburettor and gasket off the inlet manifold. Discard the gasket.

Install carburettor in the reverse order of removal, with attention to the following points:-

a) Ensure that the mating faces on the carburettor and inlet manifold are clean and free from old gasket material.

b) Use a new gasket between the carburettor and inlet manifold flange.

c) On manual choke models, reconnect the choke inner cable with the choke control knob protruding approx. 1.5 mm (0.060 in) and the choke plate fully open.

d) On automatic choke models, refill the cooling system after connecting the choke water hoses.

e) When installation is complete, set the slow running adjustment, as described previously.

Overhaul

In many cases after considerable mileage, it will probably be probably be more economical and convenient to exchange the carburettor for a new or reconditioned unit rather than attempt to overhaul or repair it. This will be particularly applicable in the case of a worn throttle spindle and its respective bore in the carburettor body.

Dismantling (Figs. D:17 and D:22)

1. On automatic choke models, remove the shouldered pivot screw retaining the fast idle cam and link rod to the lower body.
2. Remove the upper body retaining screws, and lift off the upper body. On manual choke models disconnect the choke link from the fast idle cam (Fig. D:18). Note that the manual choke cable bracket is also retained by the rear left-hand cover screw. Remove the gasket.
3. On automatic choke models, note the position of the index mark on the thermostatic spring housing, then remove the retaining screws and detach the housing.
4. Remove the two retaining screws and detach the choke housing from the carburettor upper body. Remove the retaining screw inside the housing to release the choke thermosatic lever, and lift out the vacuum piston, link and piston operating lever.
5. Withdraw the choke link operating shaft and plate assembly from the rear of the housing (Fig. D:35).
6. Extract the float pivot pin and detach the float. Remove the needle valve from its housing, then unscrew the housing and remove together with the fuel filter screen and separate the filter from the housing.
7. Unscrew the main jet (Fig. D:37).
8. If required, remove the choke plate by unscrewing the two retaining screws and sliding the plate out of the slot in the choke spindle.
9. Remove any burrs from around the screw holes in the spindle, then withdraw the shaft from the upper body.
10. Remove the accelerator pump discharge valve ball and weight from the bore in the top face of the lower body, by inverting the body.
11. Remove the four retaining screws, detach the accelerator pump cover, and disengage the pump operating arm from the operating link.
12. Withdraw the diaphragm and return spring from the accelerator pump housing. Unscrew the throttle stop and volume screws.

If required, remove the throttle plate and shaft in a similar manner as for the choke.

13. On manual choke models, remove the shouldered pivot screw, and detach the fast-idle cam and spring from the lower body.

Inspection

1. Clean all components thoroughly. The use of a genuine carburettor cleaning fluid is recommended for this purpose. Blow out all jets and passages with a low-pressure air line. NEVER use a piece of wire or similar sharp instrument for this purpose, as this may cause damage and affect the calibration of the carburettor.
2. Inspect the float, float arm, pivot pin, needle valve and housing for wear or damage.
3. Inspect the throttle and choke plates for nicks, distortion, or other damage. Examine the spindles and their respective bores in the carburettor body for binding, nicks or wear.
4. Inspect all jets for blockage or damage. Check the volume control screw for damage, especially the needle tip.

1. *Choke plate*
2. *Choke shaft*
3. *Choke lever*
4. *Fast idle lever*
5. *Fuel filter*
6. *Filter retaining plug*
7. *Fuel float*
8. *Float pivot pin*
9. *Main jet (Primary)*
10. *Accelerator pump blanking plug*
11. *Secondary throttle shaft*
12. *Primary throttle shaft*
13. *Throttle plate (primary)*
14. *Pump diaphragm*
15. *Gasket*
16. *Accelerator pump cover*
17. *Sealing ring*
18. *Locking ring*
19. *Water housing*
20. *Thermostatic spring housing*
21. *Insulating gasket*
22. *Shaft and lever assembly*
23. *Idling jet and holder*
24. *Diaphragm and shaft assembly*
25. *Choke diaphragm cover*
26. *Volume control screw*
27. *Throttle stop lever*
28. *Throttle stop screw*
29. *Throttle relay lever*
30. *Secondary throttle lever*
31. *Lower body*
32. *Emulsion tube (primary)*
33. *Accelerator pump discharge nozzle*
34. *Accelerator pump discharge valve*
35. *Air correction jet (primary)*
36. *Needle valve*
37. *Needle valve housing*
38. *Power jet diaphragm assembly*
39. *Upper body*

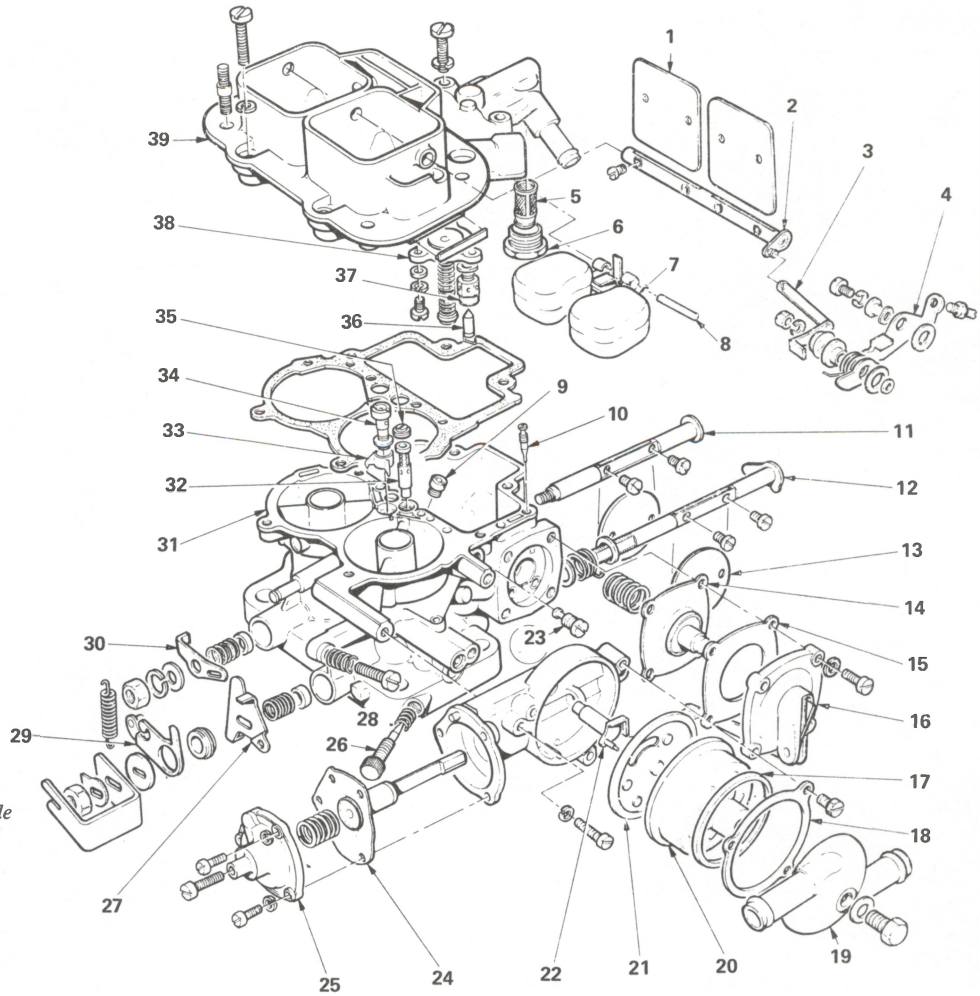


Fig. D:41 Exploded view of Weber carburettor

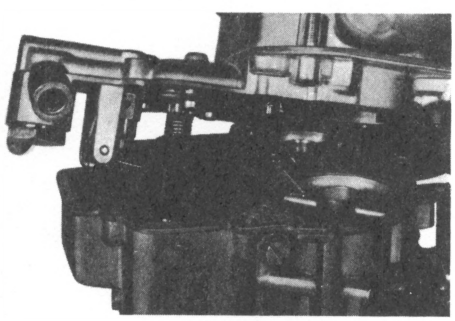


Fig. D:42 Removing carburettor upper body - Weber

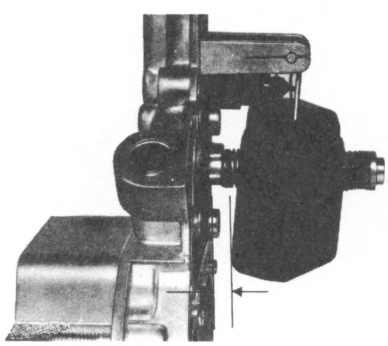


Fig. D:43 Float level setting - Weber

5. Check all mating surfaces on the carburettor bodies for distortion. Inspect the accelerator pump diaphragm for cracking or perishing. Inspect all springs for corrosion or weakness and all screws for damaged threads. Replace any parts which are defective or suspect.

Reassembly

Assemble the components in the reverse order of dismantling, with special attention to the following points:-

1. Use new gaskets, sealing rings, etc. throughout.
2. If removed, the throttle plate must be refitted with indentations positioned away from the volume control screw (Fig. D:33).
3. Before finally tightening the throttle plate (or choke plate) retaining screws, centralise the plate in the barrel with the plate in the closed position. Lock the screws by lightly peening over the threaded end. Check the shaft for full free movement.
4. Position the accelerator pump operating plate on the throttle shaft, with the 'O' mark on the lever away from the body (Fig. D:32). Secure the plate to the shaft with the screw and lock washer.
5. Operate the accelerator pump after assembly, to check the action of the return spring.
6. After finally tightening the choke plate retaining screws, check that the choke plate returns to the "closed" position when it is released.
7. On automatic choke models, exercise care when inserting the thermostatic lever operating shaft into the choke housing to avoid damaging the bushing (Fig. D:35). Fit a new gasket on the vacuum passage, locate the choke housing on the upper body and hook the U-link on the thermostatic lever operating shaft plate. Secure the housing in position with the retaining screws.
8. Use a new sealing ring when refitting the fuel filter and needle valve housing to the upper body. Install the needle valve, ball uppermost, in its housing (Fig. D:36).
9. After installing the fuel float, check the float level and travel, as described previously under "Adjustments".
10. When refitting the upper body, hold the manual choke lever in the closed position and connect the choke link to the fast idle cam. Failure to hold the choke lever in the closed position will result in the choke lever being over-centred, and the choke will be rendered inoperative. If this occurs, do NOT force the lever back to its correct position, but release the cover retaining screws, move the lever to the closed position, and then re-tighten. Position the manual choke cable bracket under the rear L.H. screws.
11. Check the choke plate pull-down and accelerator pump stroke, as described in "Adjustments".
12. On automatic choke models, fit the thermostatic spring housing, using a new gasket. Ensure the spring engages in the centre slot of the thermostatic lever (Fig. D:38). Align the mating marks on the spring housing and choke housing, then secure with the retaining screws (Fig. D:29). Check the de-choke adjustment, as described previously in "Adjustments".

WEBER CARBURETTOR - Cleaning

Periodically, clean the carburettor float chamber in a similar manner as described for the FORD carburettor.

Adjustments (Figs. D:43 and D:44)

Float Level and Travel

Remove the air cleaner and disconnect the fuel line. Disconnect the choke plate operating rod at its upper end (Fig. D:40). Remove the retaining screws and lift off the upper body.

2. Hold the upper body in the vertical position with the float hanging down Fig. D:43, and measure the distance from the upper body face to the bottom of the float with a depth gauge or similar instrument. If the float level is outside specification, adjust by bending the tab resting against the needle valve.
3. Turn the body upright, Fig. D:44, and again measure the distance from the body face to the bottom of the float. If the float travel is outside specification, adjust by bending the tab resting against the needle valve housing.
4. Refit the upper body and reconnect the choke plate operating rod. Reconnect the fuel line.

Choke Plate Pull-Down (Fig. D:45)

1. With the choke fully closed, hold the choke lever against its stop.
2. Open the choke plates against the action of the toggle spring, and using a drill or gauge rod of appropriate diameter, check that the specified clearance exists between the lower edge of the choke plates and the wall of the air intakes (Fig. D:45).
3. If adjustment is necessary, remove the water and thermostatic spring housings, and adjust the screw under the blanking plug at the rear of the pull-down diaphragm. The phasing must be checked with the fast idle screw against the cam step.

Fast Idle (Fig. D:46)

1. Connect a tachometer to the engine, and run the engine up to its normal operating temperature.
2. With the engine running at its specified speed, hold the choke lever until it is stopped by the choke linkage. Note the engine speed indicated on the tachometer.
3. If outside the specified fast idle speed, adjust by means of the fast idle screw located behind the choke housing (Fig. D:46). The choke must be set on high cam position for speed.
4. Open the throttle and fully close the choke plate, release the throttle, then allow the choke plate to return to the vertical position.
5. The fast idle adjustment can also be made statically with the carburettor removed. With the choke fully closed, measure the distance between the edge of the primary throttle plate and the throttle barrel wall adjacent to the progress holes (Fig. D:47). Adjust as described above, if necessary.

Slow Running

The carburettor slow running adjustment should be carried out in a similar manner as described for the FORD carburettor. If an exhaust gas analyser is being used, adjust the volume control screw to give 2.5 - 3.5% exhaust CO emission with the specified idle speed.

Removal and Installation

1. Remove the air cleaner.
2. Disconnect the fuel supply and distributor vacuum pipes at the carburettor.
3. Release the spring clip and disconnect the throttle control shaft from the carburettor throttle shaft (Fig. D:50).
4. Partially drain the cooling system, and disconnect the water hoses at the automatic choke housing.
5. Remove the four retaining nuts and spring washers, and lift the carburettor and gasket off the inlet manifold. Discard the gasket.
6. Install the carburettor in the reverse order of removal, with special attention to the following points:-
7. Ensure that the mating faces on the carburettor and inlet manifold are clean and free from old gasket material.

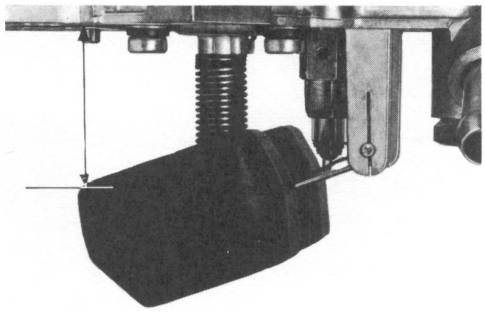


Fig. D:44 Float travel setting - Weber

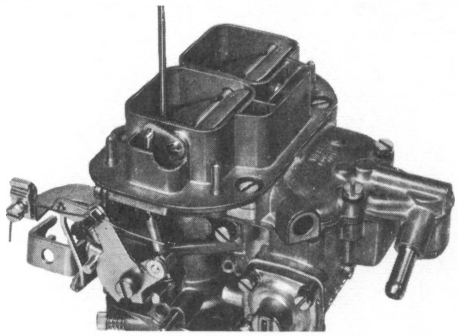


Fig. D:45 Checking choke plate pull-down setting - Weber

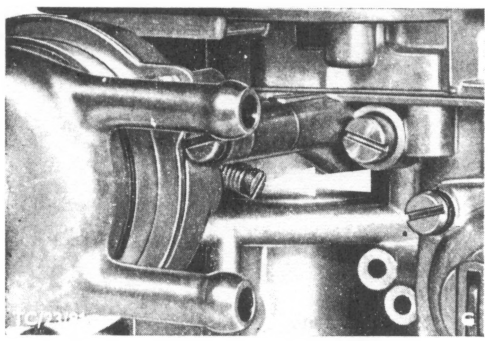


Fig. D:46 Fast idle adjustment screw - Weber

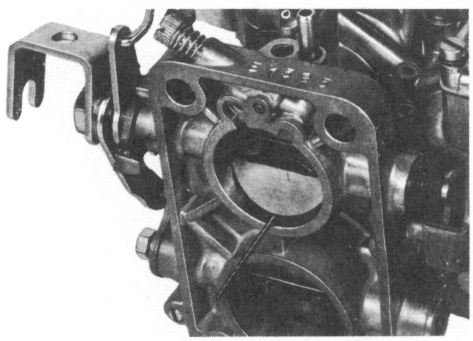


Fig. D:47 Checking fast idle setting - Weber

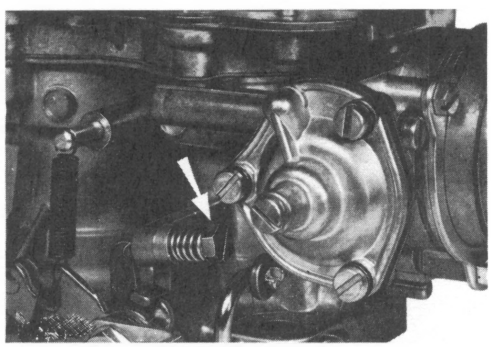


Fig. D:48 Throttle stop screw - Weber

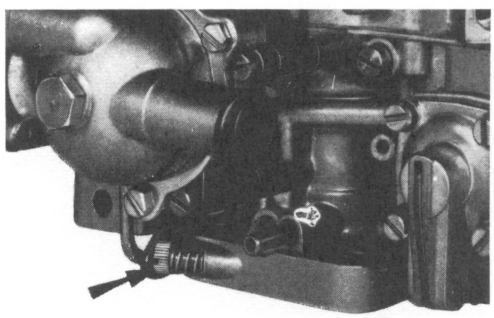


Fig. D:49 Volume control screw - Weber

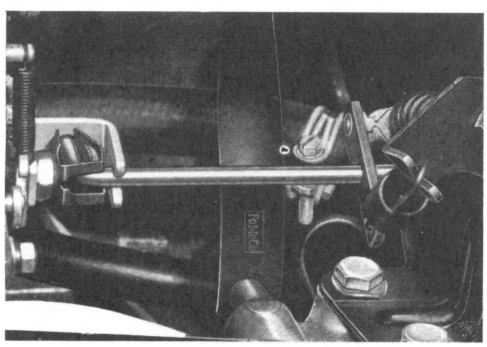


Fig. D:50 Throttle control shaft - Weber

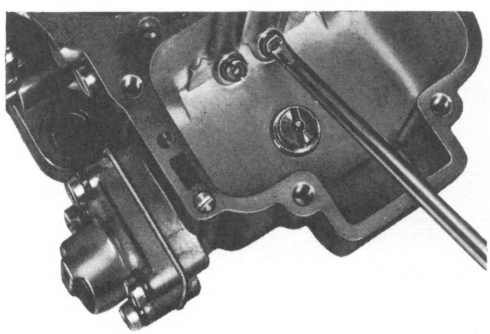


Fig. D:51 Removing primary and secondary main jets - Weber

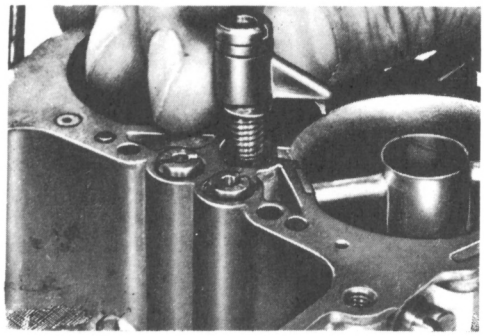


Fig. D:52 Removing accelerator pump discharge valve and jet - Weber

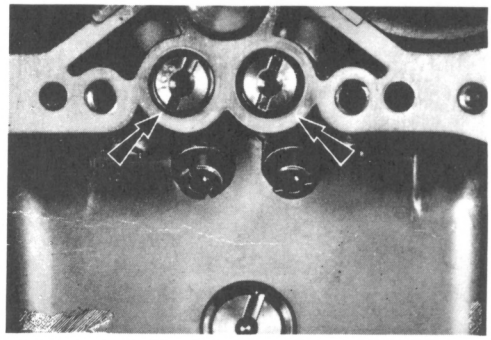


Fig. D:53 Air correction jets and emulsion tube locations - Weber

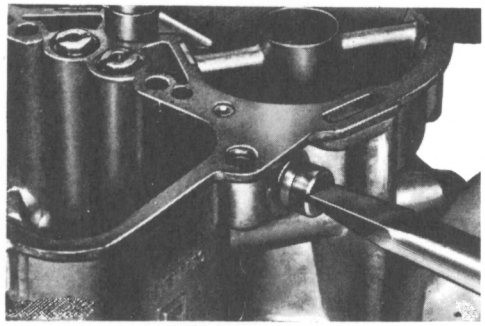


Fig. D:54 Removing idling jet holders - Weber

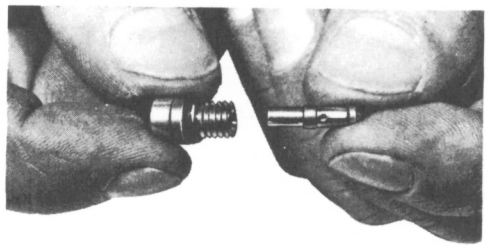


Fig. D:55 Idling jet and holder - Weber

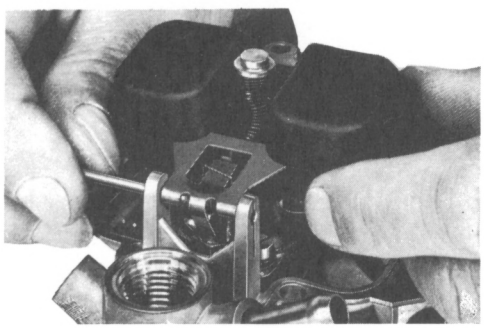


Fig. D:56 Removing float pivot pin - Weber

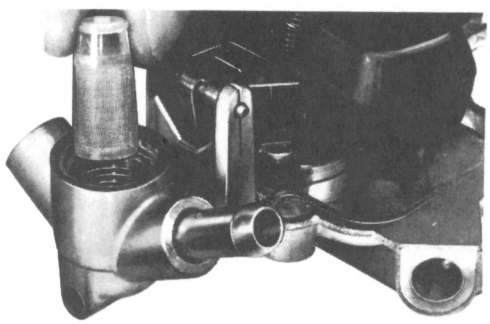


Fig. D:57 Fuel inlet filter location - Weber

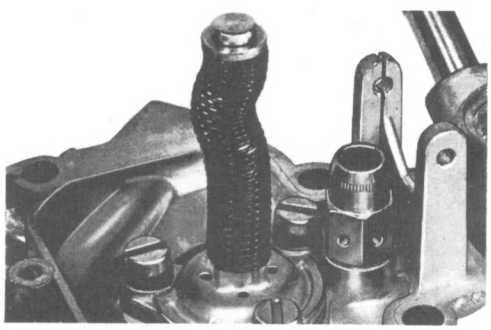


Fig. D:58 Power valve diaphragm assembly - Weber

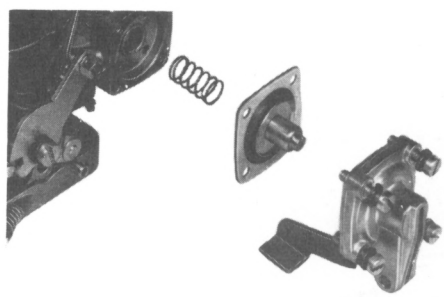


Fig. D:59 Accelerator pump assembly - Weber

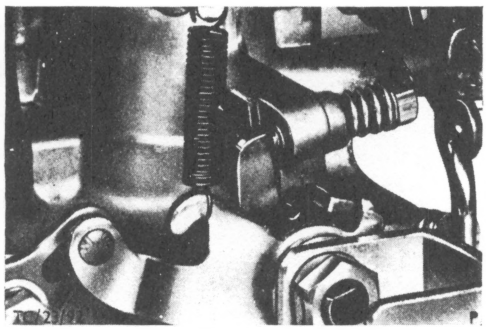


Fig. D:60 Secondary throttle return spring - Weber

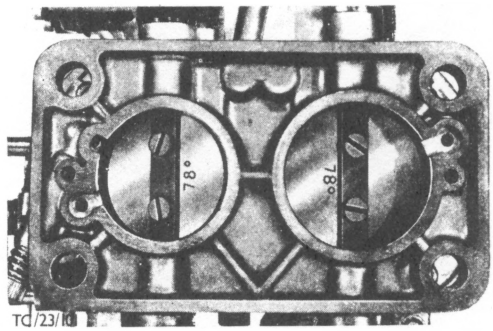


Fig. D:61 Throttle plate installation - Weber

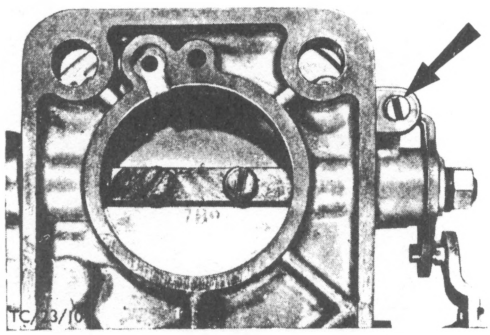


Fig. D:62 Secondary throttle plate stop screw - Weber

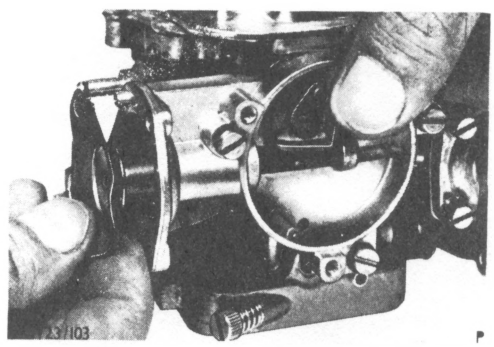


Fig. D:63 Assembling choke diaphragm - Weber

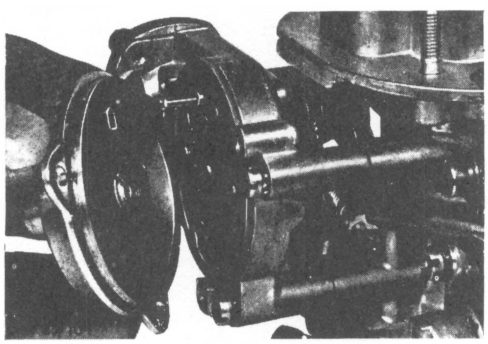


Fig. D:64 Fitting choke water housing - Weber

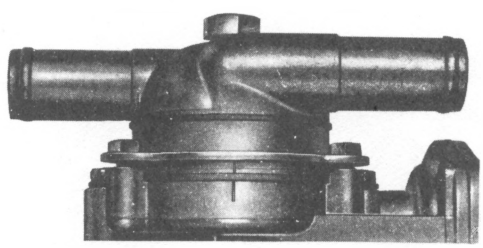


Fig. D:65 Choke housing alignment marks - Weber

8. Use a new gasket between the carburettor and inlet manifold flange.

9. Refill the cooling system, after connecting the choke water hose.

10. When installation is complete, set the slow running, as described previously.

Overhaul

In many cases, especially after considerable mileage, it will probably be more economical and convenient to exchange the carburettor for a new or reconditioned unit rather than attempt to overhaul or repair it. This will be particularly applicable in the case of worn throttle spindles and their respective bores.

Dismantling

1. Remove the spring clip and disconnect the choke plate operating rod at its upper end (Fig. D:40).

2. Remove the retaining screws and lift off the upper body.

3. Remove the gasket.

4. Remove the dust seal from the air cleaner mounting flange.

5. Unscrew the retaining plug and remove the filter from the fuel inlet (Fig. D:57).

6. Extract the float piv ot pin and detach the float and needle valve (Fig. D:56). Unscrew the needle valve housing.

7. Remove the three retaining screws and detach the power valve diaphragm assembly (Fig. D:58).

8. If required, remove the choke plates by unscrewing the retaining screws and sliding the plates out of the slots in the choke spindle.

9. Remove any burrs from around the screw holes in the spindle, then withdraw the shaft from the upper body.

10. Unscrew the primary and secondary main jets from the base of the float chamber (Fig. D:51). Do NOT remove the power valve from the centre of the float chamber floor.

11. Unscrew the accelerator pump discharge valve from the top face of the carburettor body, and remove together with the discharge nozzle (Fig. D:52).

12. Remove the air correction jets from the top of the carburettor body, invert the body and slide out the emulsion tubes (Fig. D:53).

Unscrew the idling jet holders, one from each side of the lower body (Fig. D:54), and remove the idling jets from the holders (Fig. D:55).

13. Remove the volume control screw and lock spring from the base of the body.

14. Remove the four retaining screws, detach the accelerator pump cover, and withdraw the diaphragm and return spring from the pump housing (Fig. D:59).

15. If necessary, drive the pivot pin out of the cover from the plain end with a suitable pin punch and detach the pump lever from the cover.

16. Unhook the secondary throttle return spring from the secondary throttle relay lever and the spigot on the carburettor body (Fig. D:60).

17. Release the lock tab, unscrew the nut on the primary throttle shaft, and remove the throttle control lever spacer, throttle relay lever, bush, wave washer, throttle stop lever and spring from the spindle.

18. Unscrew the nut on the secondary throttle shaft, and remove the spring washer, plain washer and throttle lever from the spindle.

19. If required, remove the primary and secondary throttle plates and shafts in a similar manner as for the choke.

20. Remove the centre-screw and detach the water housing and gasket from the choke assembly.

21. Remove the clamping ring screws, and detach the clamping ring thermostatic spring housing and insulating gasket (Fig. D:64).

22. Remove the three retaining screws and detach the diaphragm cover and return spring from the choke housing (Fig. D:63). Withdraw the diaphragm and spindle assembly.

Inspection

Clean and inspect the components in a similar manner to that described for the FORD carburettor.

Reassembly

Assemble the components in the reverse order of dismantling, with special attention to the following points:-

1. Use new gaskets, sealing rings, etc. throughout.

2. When assembling the thermostatic spring housing to the choke housing, ensure the spring loop engages the crankpin (Fig. D:64). Align the mating marks on the housings before tightening the locking ring screws (Fig. D:65).

3. If removed, the throttle plates must be refitted with the 78^{o} marks towards the lower body base (Fig. D:61).

4. Before finally tightening the throttle plate (or choke plate) retaining screws, centralise the plates in the barrels with the plates in the closed position. Lock the screws by lightly peening over the threaded end. Check the shaft for full and free movement.

5. After assembling the throttle linkage, check the clearance between the secondary throttle plate and the barrel wall at its widest point with the throttle closed. Adjust the stop, as necessary, to obtain the specified clearance (Fig. D:62).

6. When fitting the accelerator pump arm to the pump cover, enter the pivot pin plain end foremost, and drive in the pin until the serrated end is flush with the casing. After assembling the accelerator pump on the lower body, operate the pump to check the action of the return spring.

7. Ensure that the jets and emulsion tubes are installed in their correct respective locations in the lower body. If necessary, refer to TECHNICAL DATA at the end of this section for jet specifications. Fit new 'O' rings to the idling jet holders before installing.

8. If removed, the choke plate must be refitted with the "Minus" sign uppermost.

9. Use a new gasket when installing the needle valve housing in the float chamber cover. Locate the needle valve in the housing and secure the float to the pivot bracket with the pivot pin, simultaneously engaging the float with the needle valve. Check the float level and travel, as described previously in "Adjustments".

10. When assembly is complete, check the fast-idle setting choke plate pull-down and fast-idle static setting, as described in "Adjustments".

Technical Data

CARBURETTOR OR APPLICATION

1300 OHV LC Man. Trans.	Ford 71-1W-9510-JA Man. Choke
HC Man. Trans.	Ford 71-1W-9510-KA Man. Choke
Emission	Ford 71-1W-9510-RA Man. Choke
From May '75	Ford 76-1F-9510-KBA Man. Choke
1600 OHV LC Man. Trans.	Ford 71-1W-9510-BJA Man. Choke
Auto. Trans.	Ford 71-1W-9510-BNA
HC Man. Trans.	Ford 71-1W-9510-VA Man. Choke
Emission	Ford 71-1W-9510-ANA Man. Choke
Auto. Trans.	Ford 71-1W-9510-ZA Auto Choke

From May '75

Man. Trans.	Ford 75-HF-9510-KKA
Auto. Trans	Ford 75-HF-9510-KDA
1600 OHC HC/LC	Ford 75-HF-9510-KDA
1600 OHC GT Man. Trans.	Weber 71-HF-9510-BA
Auto. Trans.	Weber 71-HF-9510-CA
2000 OHC HC Man. Trans.	Weber 71-HF-9510-DA
Auto. Trans.	Weber 71-HF-9510-EA

From May '75

1600 OHC Man. Trans.	Weber 76-HF-9510-GA/GB
Auto. Trans.	Weber 76-HF-9510-HA/HB
2000 OHC Man. Trans.	Weber 76-HF-9510-AA/AB
Auto. Trans.	Weber 76-HF-9510-BA/BB

FORD JA/KA/RA CARBURETTORS (1300 OHV- Man. Choke).

	mm	in.
Throttle barrel dia.	34	1.34
Venturi dia.	25	0.98
Main jet	125	
Idling speed	780 - 820 r.p.m.	
Fast idle	1,400 - 1,600 r.p.m.	
Float-level	27.43	1.08
-travel	6.60	0.26
Choke plate pull-down	3.30	0.13
Accelerator pump stroke	2.54	0.10

FORD BHA/VA/ANA CARBS. (1600 OHV - Man. Choke).

	mm	in.
Throttle barrel dia	36	1.42
Venturi dia.	28	1.10
Main jet	145	
Idling speed	780 - 820 r.p.m.	
Fast idle	1,000 r.p.m.	
Float-level	27.93	1.10
-travel	6.60	0.26
Choke plate pull-down	3.55	0.14
Accelerator pump stroke	2.66	0.105

FORD BNA/ZA Carburettors (1600 OHV - Auto. Choke)

	mm.	in.
Throttle barrel dia.	36	1.42
Venturi dia.	28	1.10
Main jet	145	
Idling speed	780 - 820 r.p.m.	
Fast idle	2,050 - 2,250 r.p.m.	
Float-level	27.93	1.10
-travel	6.60	0.26
Choke plate pull-down	3.8	0.30
De-choke	7.62	0.30
Accelerator pump stroke	2.66	0.105
Vacuum piston link hole	Outer	
Thermostatic spring slot	Centre	

FORD KBA CARBURETTOR (1300 OHV)

	mm	in.
Throttle barrel dia.	34	1.34
Venturi dia.	25	0.98
Main jet	122	
Idling speed	775 - 825 r.p.m.	
Fast idle	1300 - 1500 r.p.m.	
Mixture % C.O.	1,5% ± 0,2	
Float level	28,25 - 29, 25 1,11 - 1,17	
Choke plate pull down	2,75 - 3,25 0,11 - 0,13	
Accelerator pump stroke	2,6 0.13 0,10 0,005	

FORD KKA/KDA CARBURETTORS (1600 OHC)

Throttle Barrel dia.	36	1,42
Venturi dia.	27	1,06
Main jet	135	
Idling speed	775 - 825 r.p.m.	
Fast idle speed	1,900 - 2,100 r.p.m.	
Mixture % C.O.	1% ± 0.2	
Float-level	28,25 - 29,75	1,11 - 1,17
Choke plate pull-down	3,57 - 4,05	0,14 - 0,16
De-choke	4,8 - 5,8	0,19 - 0,23
Accelerator pump stroke	2,77 - 3,03	0,11 - 0,005
Vacuum piston link hole	OUTER	
Thermostatic spring slot	CENTRE	
'V' mark setting	5 (0.2) Man 4,5 (0.18) Auto.	

WEBER BA/CA CARBS. (1600 GT OHC - Auto. Choke).

	Primary	Secondary
Venturi dia.	26 mm (1.02 in)	27 mm (1.06 in)
Main jet	140	135
Air correction jet	170	140
Emulsion tube	F50	F6
Idling jet	55	45
Accelerator pump jet	50 Special	
Needle valve	2,0 mm (0.08 in)	
Idling speed	800 r.p.m.	
Fast idle speed	3,200 r.p.m. on high cam	
Fast idle setting	0,85 mm (0.033 in)	
Float level - upper	35.00 - 35.50 mm (1.38 - 1.39 in)	
- lower	50.5-52.0 mm (1.97 - 2.02 in)	

Choke plate pull-down (min)	4.50 mm (0.177 in)

WEBER DA/EA CARBURETTORS (2000 OHC - Auto. Choke)

	Primary	Secondary
Venturi dia.	26 mm (1.02 in)	27 mm (1.06 in)
Main jet	140	125
Air correction jet	170	160
Emulsion tube	F50	F50
Idling jet	55	50
Accelerator pump jet	50	
Needle valve	2.0 mm (0.08 in)	
Idling speed	675 - 725 r.p.m.	
Fast idle speed	3,000 r.p.m. on high cam	
Fast idle setting	1.00 - 1.10 mm (0.039 - 0.043 in)	
Float level - upper	38.75 - 39.25 mm) (1.522-1.545 in)	
- lower	50.0 - 51.5 mm (1.97 - 2.02 in)	
Choke plate pull-down (min.)	4.00 mm (0.159 in)	

WEBER GA/GB/HA/HB (1600 OHC GT)

	Primary	Secondary
Throttle barrel dia	32	36
Venturi dia	26 mm (1.02) (1.02)	27 mm (1.06in) (1.06 in)
Main jet	130	125
Idling speed	780 - 820 r.p.m.	
Fast idle speed	1,900 - 2,100 r.p.m.	
Mixture % C.O.	1,5% ± 0,2	
Float level		
Brass float	40,5-41,5	1,59-1,63
Plastic float	34,8-35,8	1,37-1,41
Choke plate pull down	5,75-6,25	0,23-0,25
Choke phasing	2,15-2,55	0,08-0,10

WEBER AA/AB/BA/BB (2.000 OHC)

	Primary	Secondary
Throttle barrel dia	32	36
Venturi dia	26	27
Main jet	137	127
Idling speed	800 - 825 r.p.m.	
Fast idle speed	1,900 - 2,100 r.p.m.	
Mixture % C.O.	1% ± 0,2	
Float-level		
Brass float	40,5-41,5	1,59-1,63
Plastic float	34,8-35,8	1,37-1,41
Choke plate pull down	6,75-7,25	0,27-0,29
Choke phasing	2,5-3,0	0,10-0,12

FUEL PUMP

Type	Mechanical
Delivery pressure - 1300/1600	0,25-0,35 kg/cm^2 (3.5-5.0 p.s.i.)
- 1600 GT/2000	0,26-0,35 kg/cm^2 (3.75-5.0 p.s.i.)

FUEL TANK

Capacity	54.0 Litres (11.9 Imp. galls)

Clutch

GENERAL
CLUTCH ADJUSTMENT
CLUTCH CABLE
CLUTCH ASSEMBLY
TECHNICAL DATA

GENERAL

The clutch assembly on all Cortina models is of the single dry plate type with a diaphragm spring pressure plate. From early '74 the clutch disc had a damping medium built into the centre of the hub to cut down vibration.

The clutch release mechanism is cable operated, the control cable assembly being connected directly to the clutch pedal at one end and the other end being attached to the clutch release arm. Adjustment is provided at the cable abutment on the clutch housing.

The clutch release arm pivots on a fulcrum pin and carries the thrust bearing and hub assembly at its centre.

ADJUSTMENT

1. Fully depress the clutch pedal twice, then allow it to return to its stop.
2. Pull the clutch cable forwards away from its abutment on the clutch housing and check that a clearance of 3.5 mm (0.14 in) exists between the adjuster nut and its abutment (Fig.-E:2).
3. If necessary, slacken the locknut and screw the adjuster nut along the cable sleeve, until the correct clearance is obtained. Recheck the clearance after tightening the locknut.

CABLE - Replacement

NOTE: On some models, the fascia panel must first be removed to enable access to the clutch pedal connection.

1. Disconnect the battery negative earth lead.
2. Remove the rubber bung or access plate from the upper bulkhead. Detach the protective boot from the clutch housing.
3. Release the cable adjustment at its abutment until the cable ball end can be disengaged from the slotted hole in the release lever (Fig. E:4). Ensure that the lever is not accidentally disengaged from the release hub.
4. Using a small screwdriver, lever the cable eye end and pin from the retention bush on the clutch pedal (Fig. E:5).
5. Remove the pin from the cable eye and withdraw the cable assembly from the abutment tube in the dash panel.
6. Install the new clutch cable in the reverse order of removal. Adjust the release mechanism free-play, as described above.

CLUTCH ASSEMBLY - Removal

1. Remove the gearbox from the car, as described in the MANUAL GEARBOX section.
2. If the same pressure plate is to be refitted, suitably mark the pressure plate cover and flywheel, so that the assembly can be installed in the same position.
3. Release the clutch retaining bolts evenly, working diagonally across the clutch.
4. Hold the pressure plate cover, remove the bolts, and detach the pressure plate assembly and clutch disc from the flywheel.
5. Slide the release bearing assembly off the guide sleeve on the gearbox input shaft and remove the release arm from the clutch housing. Press the release bearing from its hub.

Inspection

1. Inspect the friction face of the pressure plate for scores, ridges, cracks or burn marks.
2. Inspect the assembly cover for cracks, or any distortion caused by uneven tightening or slackening of the retaining bolt.
3. Inspect the diaphragm spring for cracks, wear, or other damage, especially at the release fingers. If any defects are present, the complete pressure plate assembly must be replaced.

NOTE: Do not use solvent with a petroleum base to clean the pressure plate assembly, and do not immerse the assembly in solvent.

4. Inspect the friction linings for wear, burning, contamination by oil or grease, or looseness. Check for broken or loose springs.
5. Check for loose rivets at the hub. Inspect the hub splines for wear. The disc should slide freely on the gearbox input shaft without excessive side-play. If the linings are worn down to near the rivet heads, or if any of the above conditions are apparent, the disc must be renewed. If oil or grease contamination was present on the friction linings, the source must be determined and eliminated before fitting a new disc.

This may be due to a defective crankshaft rear seal or gearbox input shaft seal, too much lubricant in the gearbox, a blocked gearbox vent or an excessive amount of grease in the release bearing.

6. Inspect the friction surface on the flywheel. Blueing or small cracks are of no particular importance, but if there are any deep scratches, scores, cracks or heat checks, the flywheel should be machined down or replaced. See ENGINE section for the details.
7. Inspect the needle bearing in the end of the crankshaft for roughness, wear, or evidence of overheating. The bearing is a press fit in the crankshaft, and should not be loose in the bore. If any of these conditions are found, the bearing must be replaced.
8. Withdraw the bearing using a suitable extractor tool. Coat the crankshaft bore with a SMALL quantity of wheel bearing grease before installing the new bearing. Do NOT use an excessive amount of grease, as it may be thrown onto the clutch disc in use.
9. Install the new bearing using a suitably shouldered mandrel. Tap the bearing into the crankshaft bore until it is 4-5 mm (0.15-0.2 in) below the crankshaft flange.
10. Inspect the release bearing for wear, damage or looseness.
11. Hold the bearing inner race and rotate the outer race while applying pressure to it. If the bearing rotation is rough or noisy, replace the bearing. If dry through lack of lubricant, the bearing must be renewed.

NOTE: Do NOT wash the bearing in solvent as this will remove the lubricant contained in the assembly.

12. Inspect the hub bore and the outside surface of the guide sleeve on the gearbox for burrs or scoring. Any such burrs may be cleaned up with an oil stone.
13. Check that the hub slides freely on the guide sleeve.

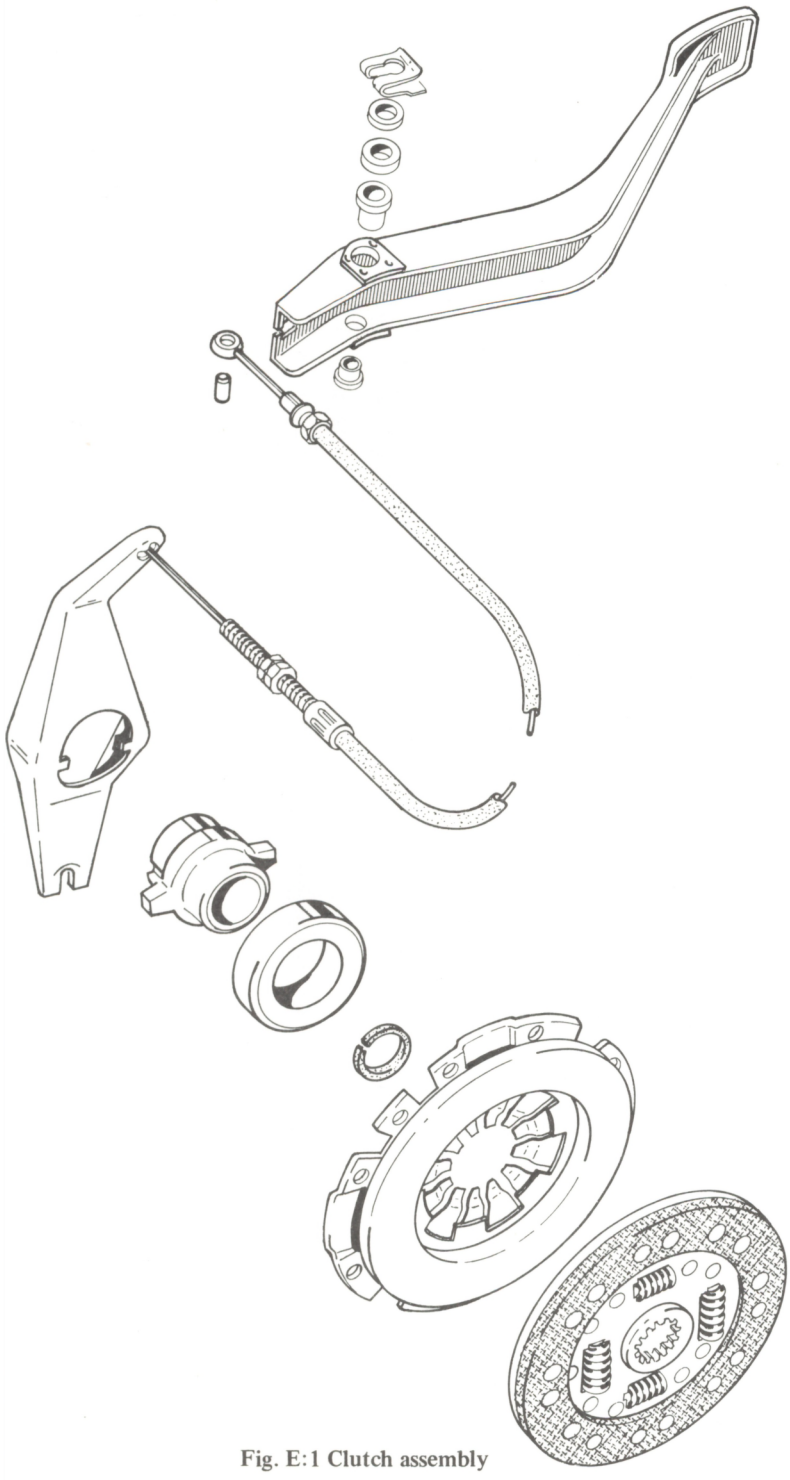


Fig. E:1 Clutch assembly

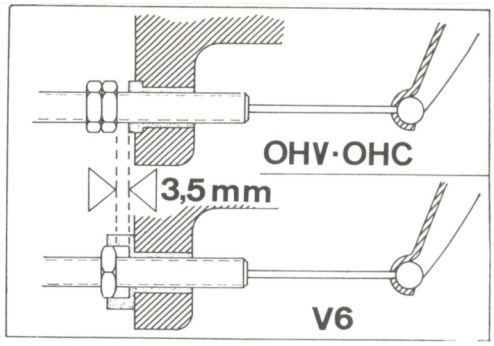


Fig. E:2 Clutch cable adjustment

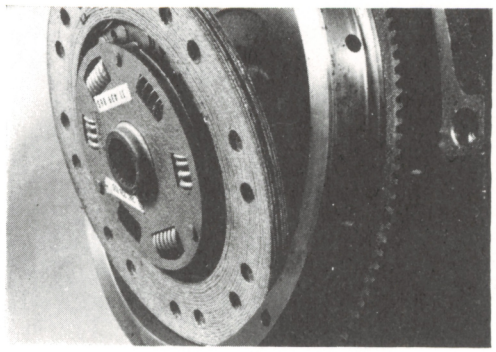


Fig. E:3 Clutch disc installation

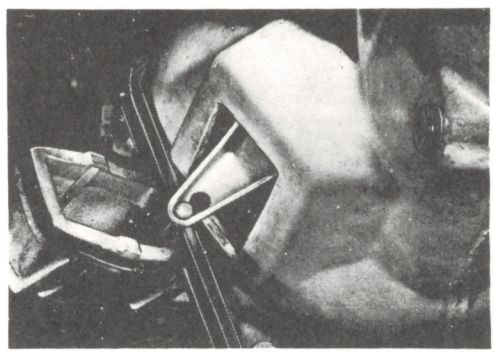


Fig. E:4 Clutch cable removed - clutch end

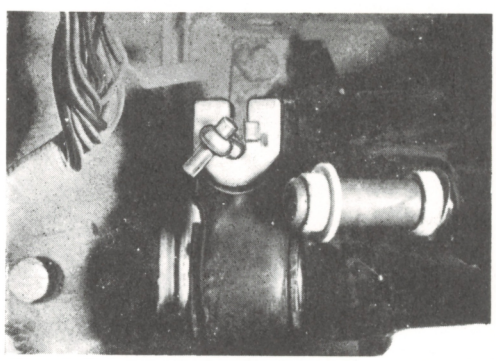


Fig. E:5 Clutch cable removed - pedal end

Inspect the release arm for wear, damage, or distortion. Replace any defective or suspect parts.

Installation

1. Apply a light film of grease to the release lever where it contacts the release bearing hub, and to the fulcrum pin pivot point.

NOTE: Do NOT use an excessive amount of grease.

2. Apply a light film of Molybedenum Disulphide type grease to the outside surface of the bearing hub guide sleeve on the gearbox.
3. Press the release bearing onto its hub.
4. Install the release lever in the clutch housing, and engage the inner end on the fulcrum pin.
5. Slide the release bearing assembly onto the guide sleeve, and engage the slots in the hub with the lugs on the release arm.

NOTE: An elastic band fitted around the release lever and the guide sleeve, will hold the bearing assembly against the lever, this will ensure that the bearing assembly is correctly located when the transmission is assembled to the engine. No need to remove the band later, as it will be destroyed in use.

6. Ensure that the friction surfaces of the flywheel and pressure plate are perfectly clean and free from oil or grease.

Cleaning the surfaces with emery cloth will remove any oil film etc.

7. Place the clutch disc in position on the flywheel with the spring retaining plate on the disc hub facing AWAY from the flywheel (Fig. E:3).
8. Align the disc using a suitable clutch centering tool or dummy shaft, and locate the pressure plate assembly on the flywheel face.

NOTE: If the original pressure plate assembly is being refitted, align the marks made prior to removal. If a new assembly is being fitted, the balance marks on the clutch cover and flywheel must be placed opposite each other. The heavy side of the pressure plate is marked with a daub of paint, while the heavy side of the flywheel is marked similarly or with a drill point.

9. Fit the clutch assembly retaining bolts, and tighten evenly to their specified torque. Remove the centering tool. Install the gearbox, as described in the MANUAL GEARBOX section.

Technical Data

Type	Single dry plate, diaphragm spring
Actuation	Cable

	1300/1600cc OHV	1600GT/2000cc OHC
Disc dia. up to 1974	189 mm (7.44 in)	215 mm (8.46 in)

	1300/OHV 1600/OHC	2000/OHC
Disc dia 1974 on	190,9 mm (7.5 in)	215,9 mm (8.5 in)
Torsional springs	4	6
Lining thickness-New	7.2 mm (0.28 in)	8.4 mm (0.33 in)
-Min.	2.0 (0.08 in)	3.0 mm (0.12 in)
Diaphragm contact pressure	385 kg (849 lb)	450 kg (992 lb)

Cable free play	3.5 mm (0.14 in)
Free play at pedal	NIL
Pedal stroke	165 mm (6.5 in) plug 19 mm (0.75 in) allowance for wear.

Gearbox

GENERAL
GEARBOX REMOVAL AND INSTALLATION
GEARBOX OVERHAUL (ALL TYPES)
TECHNICAL DATA

GENERAL

Three different gearbox versions are used in the various models; all have four forward gears and one reverse. All forward gears are engaged through blocker ring synchromesh units. A detachable clutch housing is fitted to each version, unlike the German Taunus models which have an integral clutch housing.

In this section, the versions are referred to as Type "A", "B" & "C" gearboxes.

Type "A" is fitted to 1600 and 2000 OHC vehicles and is a slightly modified version of the Escort gearbox (Fig. F:1). This gearbox is also used on German Taunus models, but in that application a modified input shaft and an integral clutch housing is fitted.

Type "B" is used on all O.H.V. models (1300 & 1600) with bucket front seats. This gearbox, with slight deviation, is similar to the one used on Capri models (Fig. F:2).

Both the Type "A" & "B" gearboxes are of the single rail type with remote control selector mechanism. The Type "C" has a three rail semi-remote selector mechanism, and is fitted to 1300 & 1600 O.H.V. vehicles with bench front seats. This gearbox is similar to the one used in early 1300 and 1600 cc Cortina Mk II models (Fig. F:3).

GEARBOX - Removal

1. Disconnect the battery.
2. On O.H.V. engines, remove the engine dipstick.
3. On models with centre console:-

a). Push both front seats fully forwards.

b). Remove the parcel tray retaining bolts, and remove the parcel tray from above the handbrake lever.

c). Remove the knob and locknut from the gear lever.

d) Remove the centre console and instrument cluster attaching bolts.

e) Disconnect all leads from the instrument cluster, after marking to ensure correct reconnection, and withdraw the harness from the console.

f) Remove the centre-bolt from the handbrake lever, then pull the lever handle fully up.

g) Push both front seals fully back, and remove the console.

4. On Types A & B gearbox, lift the gear lever gaiter, and remove the reverse stop spring "U" retainer from the gear lever (Fig. F:4). Prise open the locking tab, release the dome nut, and lift out the gear lever.
5. On Type C gearbox, lift the gear lever gaiter, release the dome nut, and lift out the gear lever.
6. Disconnect the propshaft at the rear axle, after marking the flange alignment. On models with split-type propshaft, unbolt the centre bearing from the underbody.
7. Remove the propshaft. Fit a dummy yoke or other suitable plug in the gearbox extension housing, to prevent loss of oil.
8. Disconnect the starter motor leads. Remove the starter motor retaining bolts, and withdraw the starter motor.
9. Detach the engine rear cover plate and bracket assembly from the clutch housing and cylinder block, and swing clear.
10. Release the clutch cable adjustment, detach the release lever gaiter. Disconnect the cable ball end from the release lever, and the cable conduit from the abutment on the clutch housing.
11. Detach the exhaust mounting bracket and down pipe from the exhaust manifold.
12. Remove the circlip (bolt and forked retainer on Type C gearbox) and withdraw the speedometer cable from the gearbox extension housing (Fig. F:5).
13. If fitted, disconnect the leads from the reverse light switch at the rear of the extension housing.
14. Remove the clutch housing to engine bolts.
15. Support the gearbox, and detach the crossmember assembly from the extension housing and underbody.
16. Insert a wooden block between the engine sump and front crossmember, to prevent the engine dropping after removal of the gearbox.
17. Withdraw the gearbox rearwards to disengage the input shaft splines from the clutch, lower the gearbox, and remove from under the car.

Installation

Install the gearbox in the reverse order of removal, with attention to the following points:-

1. Before mating the clutch housing to the engine, check the correct position of the engine rear cover plate. Also, using a suitable alignment tool, check that the clutch disc is correctly centered.
2. Grease the gearbox input shaft splines, prior to installing the gearbox - just a smear of HMP grease will do.
3. Once installed, secure the clutch housing in position by fitting two bolts on opposite sides of the housing.
4. Ensure that the seal on the engine rear cover plate is correctly positioned when installing.
5. Adjust the clutch control cable, as described in the CLUTCH section.
6. When reconnecting the starter motor leads, ensure that they will not be too close to the exhaust.
7. Ensure that the marks on the propshaft and rear axle flanges are correctly aligned before fitting the flange bolts.
8. Tighten all nuts and bolts to their specified torques.
9. If drained refill the gearbox with the recommended grade of oil. Ensure that the car is level when checking the oil level.
10. When installation is complete, check that all gears are obtainable.

Overhaul (Type "A")

Dismantling

1. If not already drained, remove the drain plug, and drain out the gearbox lubricant.
2. Remove the clutch release bearing and release arm. Remove the retaining bolts, and detach the clutch housing and gasket from the gearbox front face.

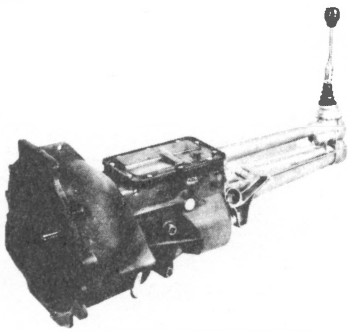


Fig. F:1 Type A gearbox

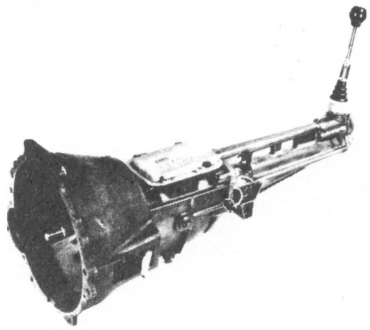


Fig. F:2 Type B gearbox

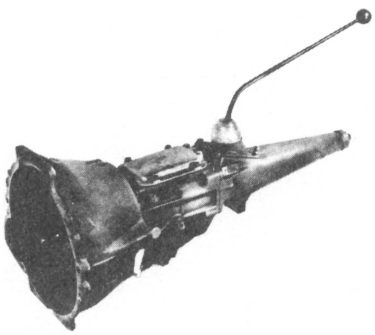


Fig. F:3 Type C gearbox

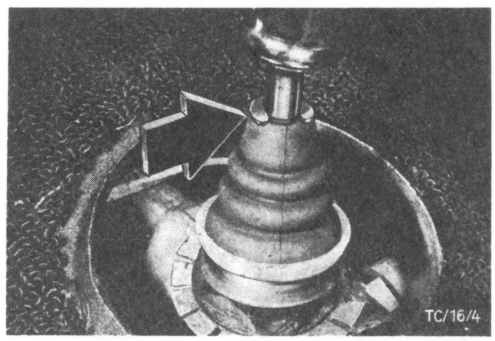


Fig. F:4 Reverse stop spring

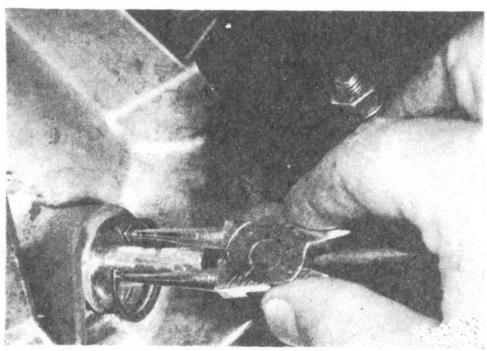


Fig. F:5 Speedometer cable retaining circlip

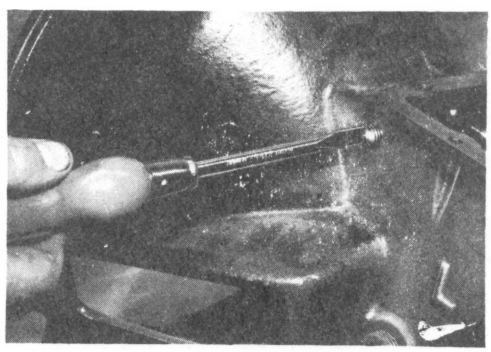


Fig. F:6 Detent spring retaining plug - Type 'A'

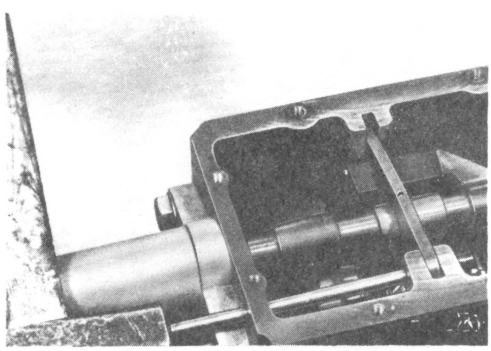


Fig. F:7 Driving out lock plate pivot pin - Type 'A'

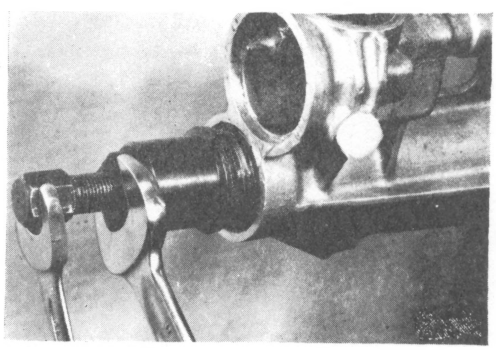


Fig. F:8 Removing extension housing oil seal - Type 'A'

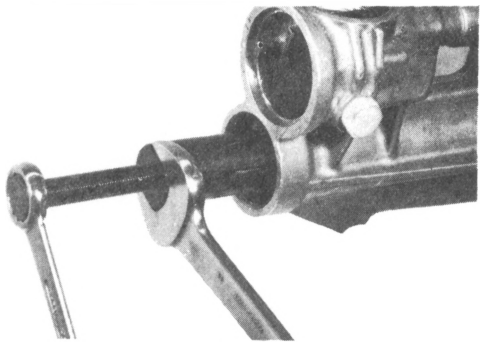


Fig. F:9 Removing extension housing bush - Type 'A'

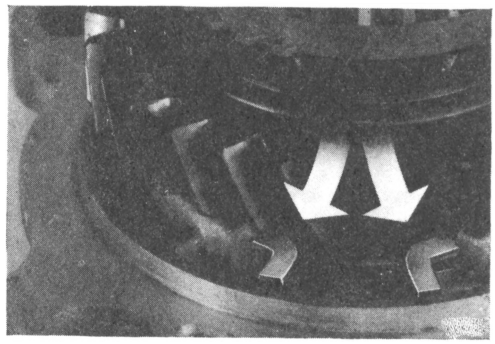


Fig. F:10 Mainshaft bearing retaining circlip - Type 'A'

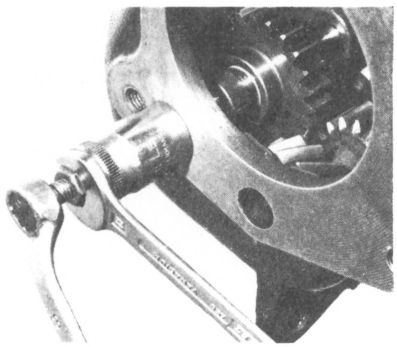


Fig. F:11 Withdrawing reverse idler shaft - Type 'A'

1. *Synchroniser rings*
2. *3rd/4th synchroniser assembly*
3. *3rd gear*
4. *2nd gear*
5. *1st/2nd synchroniser assembly*
6. *Circlips*
7. *Maindrive gear bearing*
8. *Main drive gear (input shaft)*
9. *Needle roller spigot bearing*
10. *Main shaft*
11. *Oil scoop washer*
12. *Mainshaft bearing*
13. *Speedometer drive gear*
14. *1st gear*
15. *Spacer sleeve*
16. *Spacer ring*
17. *Needle rollers*
18. *Thrust washer*
19. *Countershaft*
20. *Countershaft cluster gear*
21. *Reverse idler gear*
22. *Idler gear shaft*

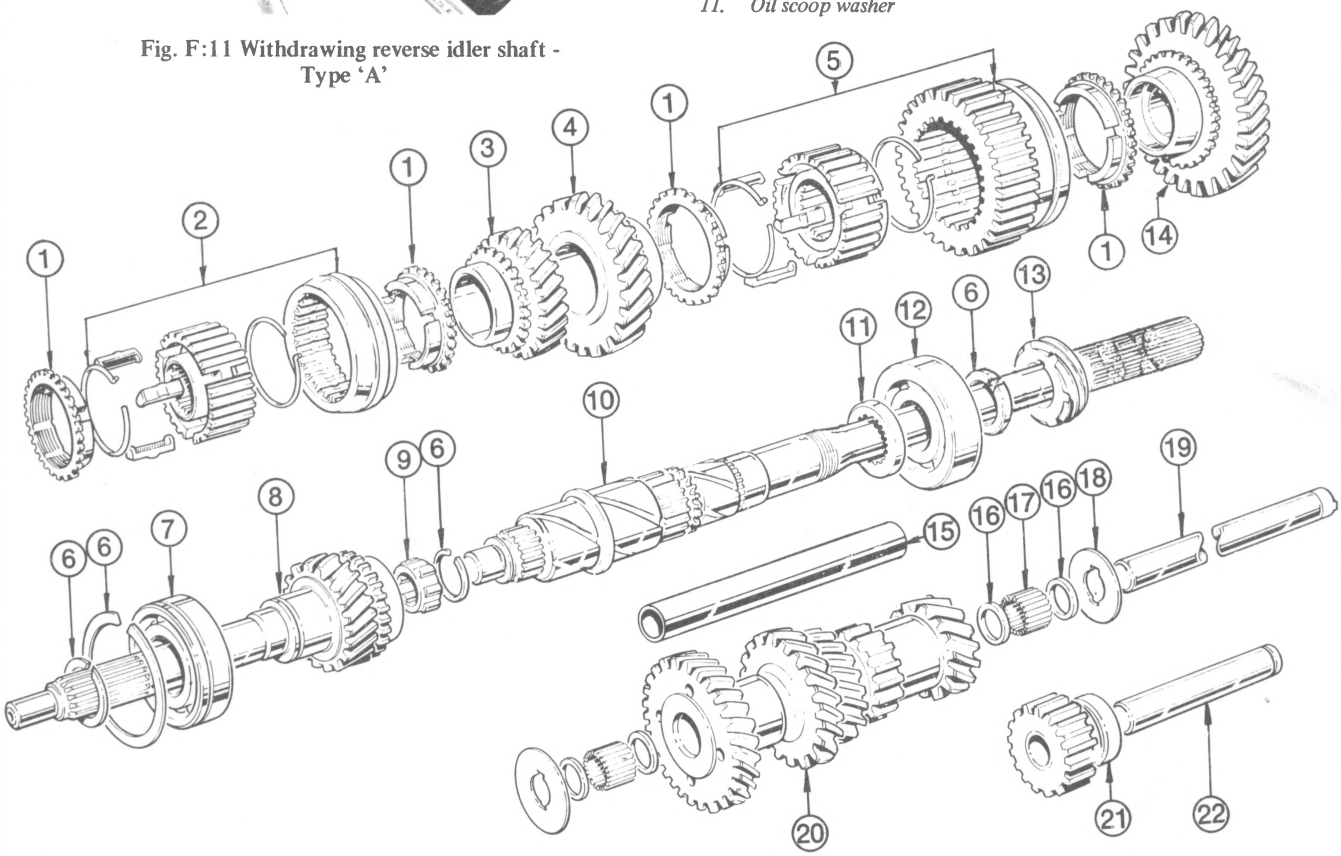


Fig. F:12 Exploded view of gearbox internals - Type 'A'

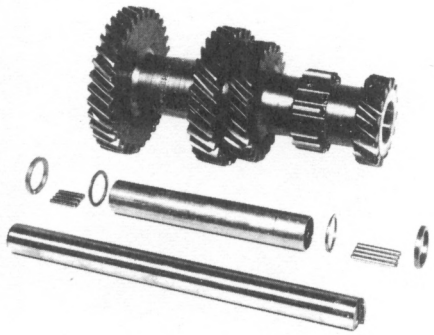


Fig. F:13 Countershaft gear assembly - Type 'A'

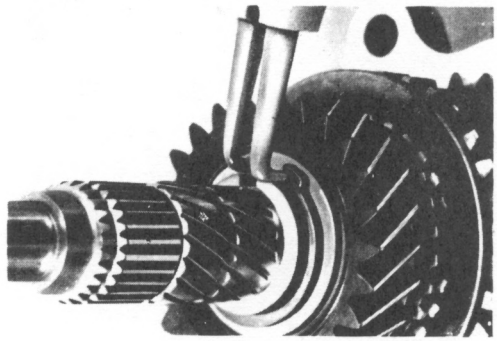


Fig. F:14 Removing 2nd, gear circlip Tyep 'A'

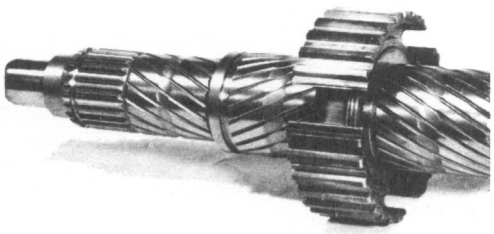


Fig. F:15 Mainshaft and integral 1st/2nd synchroniser hub - Type 'A'

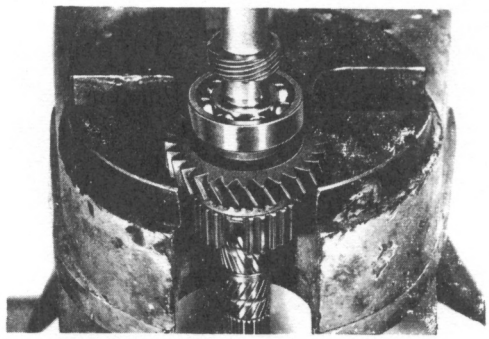


Fig. F:16 Pressing 1st gear and bearing off mainshaft - Type 'A'

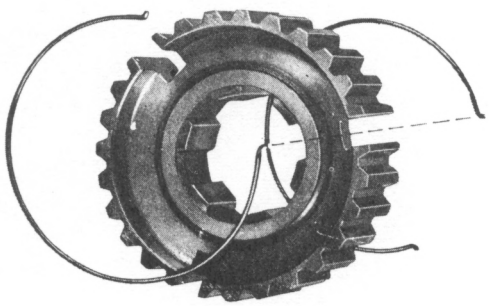


Fig. F:17 Location of blocker springs in synchroniser hub - Type 'A'

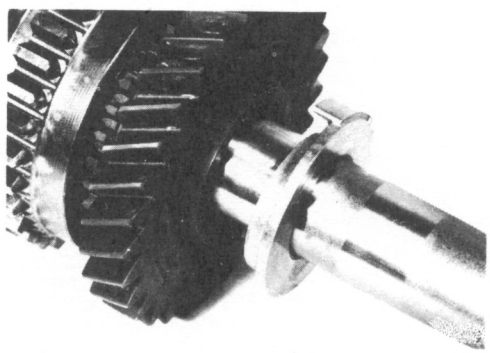


Fig. F:18 Location of oil scoop washer at 1st gear - Type 'A'

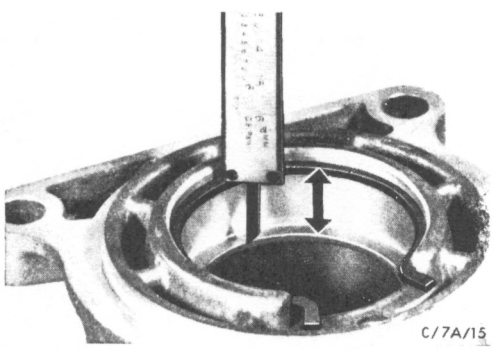


Fig. F:19 Measuring overall depth of bearing housing - Type 'A'

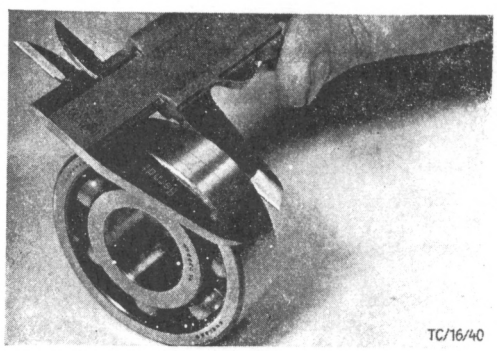


Fig. F:20 Measuring width of mainshaft bearing outer race - Type 'A'

3. Remove the cover plate from the top of the gearbox.

4. Prise the blanking plug from the rear of the extension housing.

5. Remove the detent spring retaining screw from the left-hand side of the gearbox casing (Fig. F:6). Using a suitable punch, drive out the spring pin securing the selector boss to the selector rail.

6. Tap out the lock plate pivot pin from the bore in the gearbox casing. It will facilitate removal of the pivot pin if the blanking plug is first removed from the rear face of the gearbox (Fig. F:7).

7. Remove the detent spring and plunger from the bore in the side of the gearbox. Withdraw the selector rail from the rear, and lift out the selector forks, selector boss, and lock plate.

8. Remove the oil seal from the rear of the extension housing, using Tool No. GE - 7657A1 (Fig. F:8). Similarly, withdraw the bush with Tool No. G3 - 7041A2 (Fig. F:9).

9. Remove the bolts securing the extension housing to the gearbox casing. Withdraw the housing rearwards slightly, until it is possible to rotate it so that the cut-out in the housing flange aligns with the countershaft.

10. Using a brass drift, drive the countershaft rearwards, until it is just clear of the front of the gearbox. Insert a dummy countershaft (e.g. Tool No. 16002) into the countershaft bore from the front, and push the countershaft completely out of the gearbox.

11. The countershaft cluster gear will now drop to the bottom of the gearbox allowing the extension housing and mainshaft assembly to be withdrawn from the rear. If necessary, lever the selector rail oil seal out of the bore in the gearbox casing with a screwdriver.

12. Remove the retaining plug from the side of the extension housing, and withdraw the speedometer driven gear.

13. Remove the circlip retaining the mainshaft bearing in the extension housing (Fig. F:10) and tap the mainshaft assembly out of the housing, with a hide mallet. If necessary, lever the speedometer drive oil seal out of the extension housing with a screwdriver.

14. Remove the retaining bolts, and detach the main drive gear bearing retainer and sealing ring from the gearbox front face.

15. Remove the oil seal from the bearing retainer, with a screwdriver. Withdraw the main drive gear from the gearbox front face, and remove the mainshaft spigot bearing from the recess in the gear.

16. Remove the circlip securing the bearing on the main drive gear shaft, and press off the bearing.

17. Locate a nut, flat washer, and socket on an M8 x 60 mm bolt, screw the bolt into the reverse idler gear. Remove the circlip, and slide the reverse relay arm off the fulcrum pin on the gearbox casing.

18. Lift the countershaft gear and the two thrust washers out of the gearbox. Withdraw the dummy shaft from the cluster gear, and remove the needle rollers and four spacer rings from each end of the cluster gear, and spacer sleeve from the gear bore (Fig. F:13).

19. Remove the circlip at the front end of the mainshaft, and withdraw the 3rd/4th gear synchroniser hub and 3rd gear assembly from the shaft.

20. Pull the synchroniser sleeve off the hub, and withdraw the block bars and springs.

21. Remove the circlip and thrust washer from in front of the 2nd gear (Fig. F:14), and withdraw the gear off the front of the mainshaft.

22. Pull the synchroniser sleeve off the 1st/2nd gear synchroniser hub, and withdraw the blocker bars and springs.

NOTE: The 1st/2nd gear synchroniser hub and mainshaft are an integral unit and therefore must NOT be dismantled further (Fig. F:15).

23. Remove the circlip retaining the mainshaft bearing on the rear end of the mainshaft.

24. Position the mainshaft assembly in a press, as shown in Fig. F:16, and press the 1st gear, oil scoop ring, mainshaft bearing and speedometer drive gear off the mainshaft.

25. Remove the 1st gear synchroniser ring.

Reassembly

Before installation the threads of all bolts and screws exposed to oil in the gearbox should be coated with suitable sealer.

NOTE: Use only new circlips when reassembling (Fig. F:24).

1. Slide the 1st/2nd gear synchroniser sleeve onto the synchroniser hub, with the mating marks on the hub and sleeve aligned. The selector fork groove on the sleeve must be towards the rear of the mainshaft.

2. Locate a blocker bar in each of the three slots cut in the hub. Fit a blocker spring in the 1st gear (rear) end of the hub under the blocker bars, with the hooked end of the spring located in the "U" section of one of the blocker bars.

3. Fit the other blocker spring to the opposite face (2nd gear side) of the hub, and locate the hooked end in the SAME blocker bar as the spring just fitted.

When viewed directly from their respective ends of the synchroniser unit, both springs should be located so that their direction of rotation from the hooked end is the same (Fig. F:17).

4. Fit the synchroniser ring on the cone of the 2nd gear, and slide the gear onto the mainshaft from the front. Fit the thrust washer, and secure the gear on the shaft with a new circlip.

5. Fit the synchroniser ring on the cone of the 1st gear, and slide the gear onto the mainshaft from the rear.

6. Fit the oil scoop washer against the 1st gear with the broad face of the washer AWAY from the gear (Fig. F:18).

7. To determine the correct mainshaft bearing to extension housing circlip thickness, first fit a circlip in the extension housing groove, press the circlip outwards so that it bears against the groove shoulder, then accurately measure the dimension from the OUTSIDE face of the circlip to the extension housing shoulder with a depth gauge (Fig. F:19).

8. Now measure the width of the ball bearing outer race, as shown in Fig. F:20. Deduct the bearing race thickness from the measured overall housing depth to obtain the required circlip thickness.

Example:

Overall housing depth	17.98 mm (0.70 in)
Bearing race thickness	15.92 mm (0.60 in)
Required circlip thickness	2. .06 mm (0.10 in)

9. Slide the selected circlip loosely onto the mainshaft, press the ball race fully home on the shaft, bearing only on the inner race of the bearing, and secure with a new circlip.

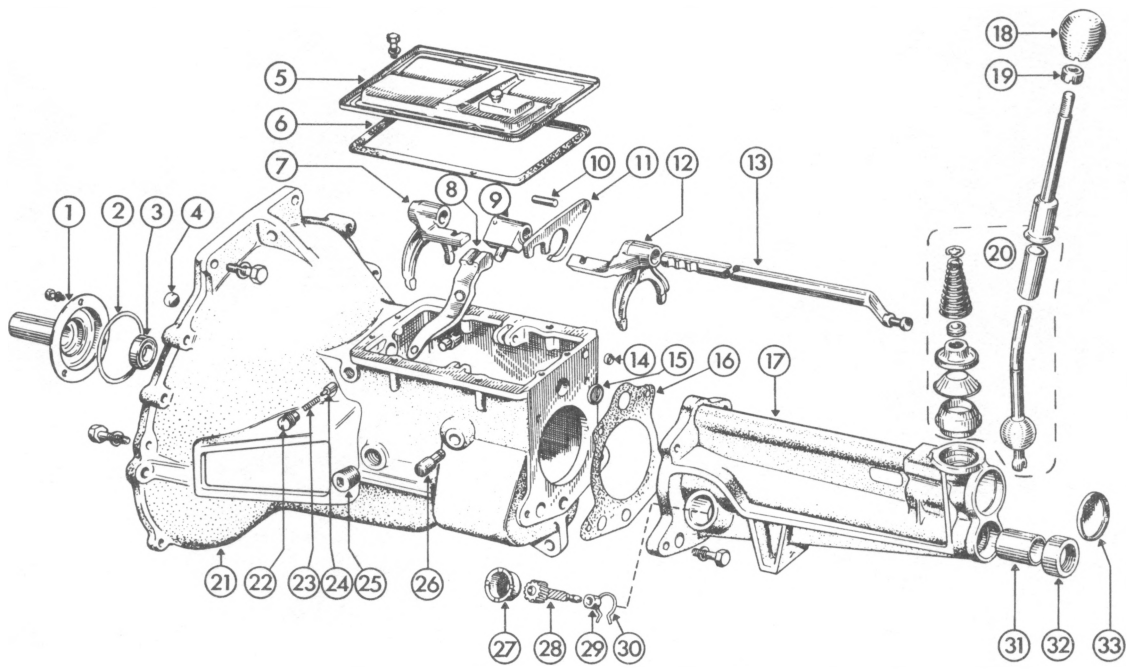
10. Select the widest possible circlip to fit the groove so that no end-float exists (Fig. F:22).

11. Fit the speedometer drive gear onto the shaft so that the distance from the speedometer gear race to the bearing front face is 51.2 mm (2.03 in) (Fig. F:23).

12. Slide the 3rd gear onto the mainshaft from the front, and place a synchroniser ring on the gear cone.

13. Assemble the 3rd/4th gear synchroniser assembly in the same manner as described for the 1st/2nd gear synchroniser. Press the synchroniser assembly onto the mainshaft with the broad shoulder of the hub facing rearwards, and secure with a new circlip.

14. Fit the reverse relay arm onto the fulcrum pin, and



1. *Guide sleeve*
2. *O-ring*
3. *Oil seal*
4. *Blanking plug*
5. *Top cover plate*
6. *Gasket*
7. *3rd/4th selector fork*
8. *Reverse selector fork*
9. *Selector lock plate*
10. *Pivot pin*
11. *Selector lock plate*
12. *1st/2nd selector fork*
13. *Selector rail*
14. *Blanking plug*
15. *Selector rail sealing ring*
16. *Gasket*
17. *Extension housing*
18. *Gear knob*
19. *Locking nut*
20. *Gear lever assembly*
21. *Gearbox casing*
22. *Detent retaining plug*
23. *Detent spring*
24. *Selector detent plunger*
25. *Oil filler plug*
26. *Reverse relay lever pivot pin*
27. *Speedometer gear retainer*
28. *Speedometer driven gear*
29. *Sealing ring*
30. *Circlip*
31. *Bushing*
32. *Oil seal*
33. *Blanking plug*

Fig. F:21 Exploded view of gearbox casing - Type 'A'

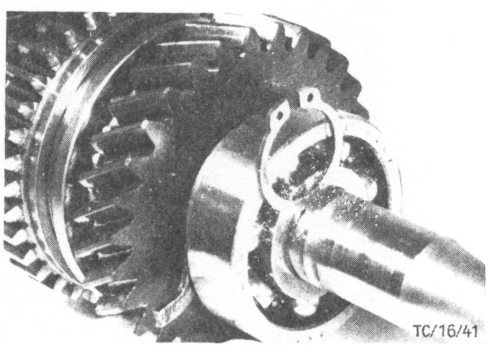


Fig. F:22 Selecting mainshaft bearing circlips - Type 'A'

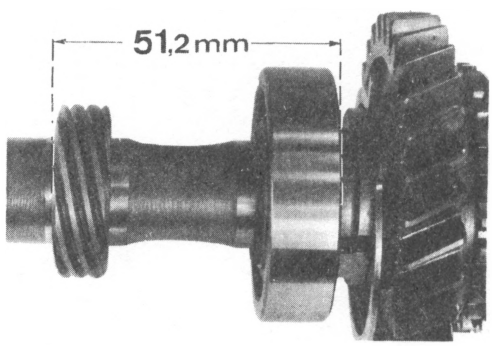


Fig. F:23 Location of speedometer drive gear - Type 'A'

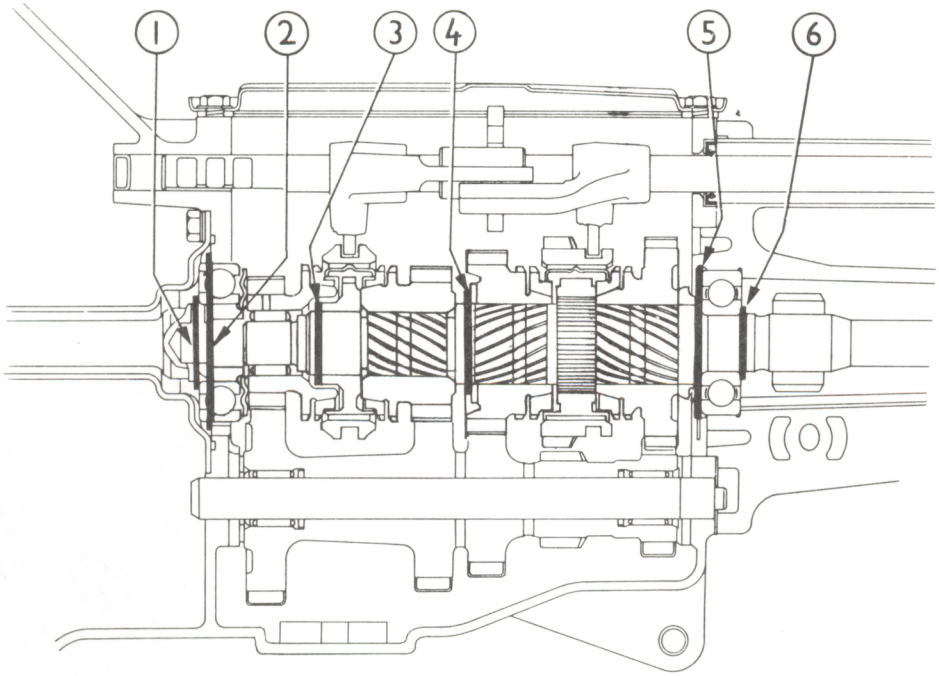


Fig. F:24 Circlip locations in gearbox - Type 'A'
(Circlips 1,5 & 6 are selective)

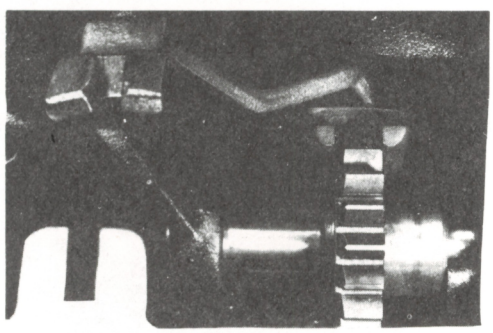


Fig. F:25 Reverse idler gear installation - Type 'A'

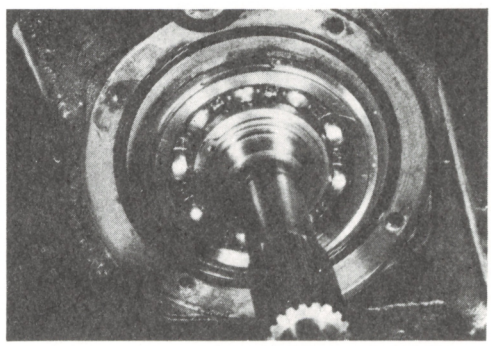


Fig. F:26 O-ring location in gearbox front face - Type 'A'

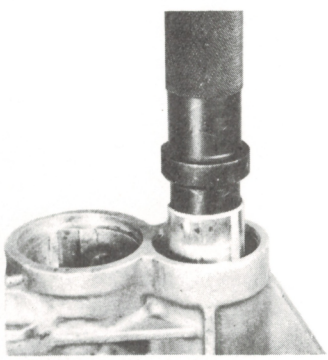


Fig. F:27 Installing extension housing bush - Type 'A'

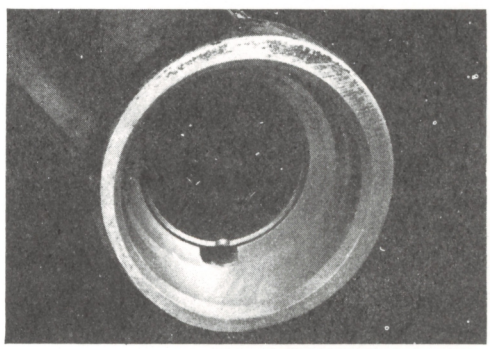


Fig. F:28 Extension housing bush alignment - Type 'A'

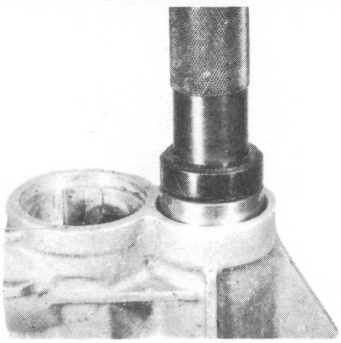


Fig. F:29 Installing extension housing oil seal - Type 'A'

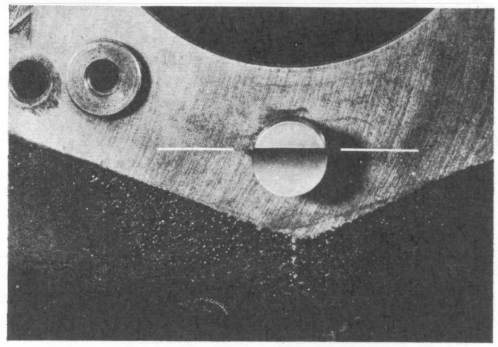


Fig. F:30 Location of countershaft rear shoulder - Type 'A'

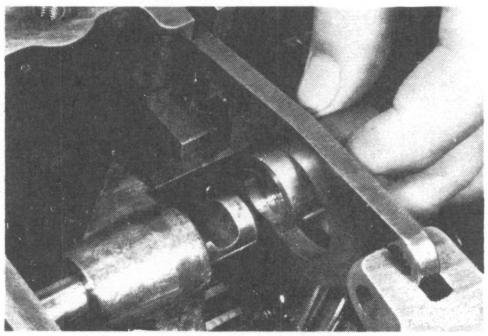


Fig. F:31 Assembling selector mechanism - Type 'A'

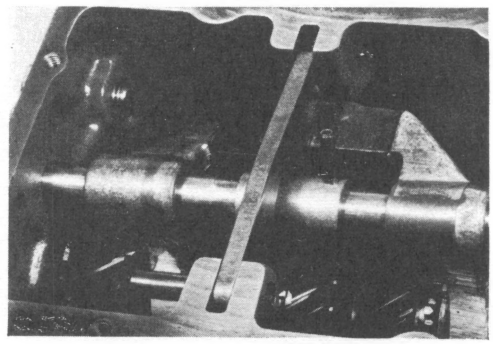


Fig. F:32 Selector boss retaining pin and lock plates fulcrum pin - Type 'A'

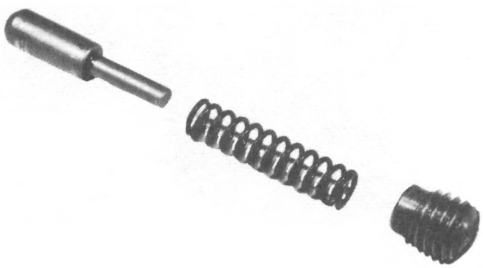


Fig. F:33 Detent plunger, spring and retaining plug - Type 'A'

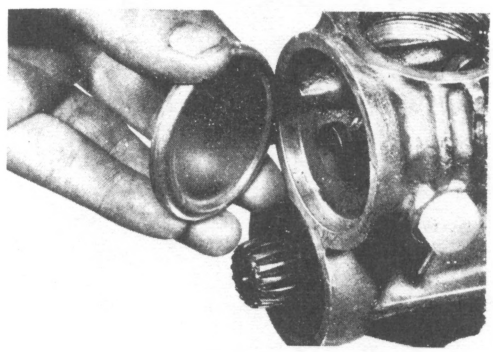


Fig. F:34 Fitting extension housing blanking plug - Type 'A'

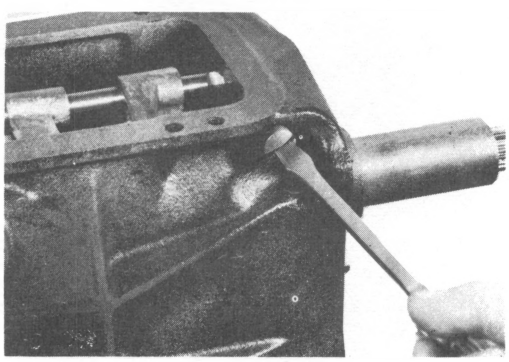


Fig. F:35 Detent spring retaining screw - Type 'B'

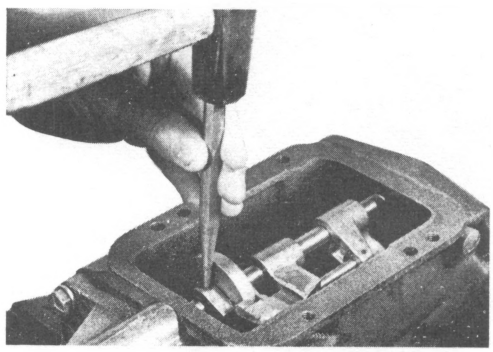


Fig. F:36 Tapping out selector boss retaining pin - Type 'B'

secure with a new circlip. Fit the reverse idler gear into the fork groove with the long journal towards the rear (Fig. F:25).

15. Tap the idler shaft into the casing and through the gear from the rear, using a copper mallet.

16. Insert the spacer sleeve into the cluster gear, then fit the dummy countershaft, Tool No. 16002, into the gear bore. Fill the remaining bore space with grease.

17. Place one of the thin spacer rings over the dummy shaft, and push it into the front (large gear) end of the gear bore.

18. Grease the shorter needle rollers and assemble them in the recess. Fit one of the thick spacer rings to the ends of the bearing needles. Similarly, assemble the long needle rollers in the rear (small gear) end of the cluster gear bore (Fig. F:13).

19. Grease the two thrust washers, and position one at each end of the gear. Ensure that they are correctly located in the recess in the gear.

20. Carefully lower the cluster gear assembly into position in the gearbox. Ensure that the thrust washer 'ears' are located on each side of the location boss.

21. Press the bearing fully home on the main drive gearshaft. The circlip groove on the outer race of the bearing should be towards the front of the shaft.

22. Secure the bearing on the shaft with a new circlip, using the thickest circlip which will fit in the shaft groove. Fit a new large circlip to the periphery of the bearing.

23. Using a copper drift and tapping only on the OUTER race of the bearing, install the main drive gear in its bore in the gearbox front face until the large circlip bears against the casing shoulder.

Take care during this operation to avoid damaging the dog teeth on the countershaft cluster gear.

24. Fit a new oil seal in the bearing retainer, with the lip of the seal facing towards the gearbox case.

25. Install a new O-ring in the groove on the gearbox front face (Fig. F:26).

26. Cover the main drive gear splines with masking tape, to prevent damage to the retainer oil seal. Lightly grease the sealing surface of the oil seal, ensure that the return hole in the retainer is properly aligned, and tighten the retainer bolts to their specified torque. Remove the masking tape.

27. Press a new bush into the rear of the extension housing, using Tool No. G3-7041B2 (Fig. F:27). Ensure that the recess in the bush is aligned with the oil return groove in the housing (Fig. F:28). Install a new oil seal in the housing, using Tool No. G3-7657B1 to drive it squarely into position (Fig. F:29).

28. Press the mainshaft into the extension housing, and secure with the circlip loosely fitted earlier (Fig. F:10).

It will facilitate centralising of the mainshaft if the prop shaft yoke is inserted into the rear of the extension housing.

29. Install a new speedometer drive oil seal in the extension housing, and fit the speedometer drive gear. Secure in position with a new retainer plug coated with sealing compound.

30. Install a new selector rail oil seal in the rear face of the gearbox casing.

31. Oil the mainshaft needle roller spigot bearing, and fit it in the centre recess of the main drive gear. Fit the synchroniser ring on the cone of the 4th gear.

32. Coat a new extension housing gasket with sealing compound, and place it on the extension housing. Pass the mainshaft assembly into the gearbox, and slide it into position after pulling the 3rd/4th gear synchroniser sleeve slightly forwards to give clearance between sleeve and countershaft cluster gear.

Take care when entering the front spigot into the bearing in the main drive gear to avoid dislodging the needle rollers.

33. Turn the extension housing until the cut-away on the housing aligns with the countershaft aperture in the rear face of the gearbox. Ensure that both the countershaft cluster gear thrust washer are properly aligned and not displaced during this operation.

34. Insert the countershaft from the rear, and keeping it in permanent contact with the dummy shaft, tap it fully home using a hide or copper mallet. Ensure that the shoulder on the rear of the countershaft is positioned as shown in Fig. F:30.

35. Rotate the extension housing until the bolt holes align, then push the housing fully home onto the gearbox case. Coat the threads of the retaining bolts with sealing compound, fit the bolts, and tighten to their specified torque.

36. Engage the selector forks on the synchroniser sleeves with synchroniser sleeves in the neutral position.

37. Align the selector boss and selector lock plate, and carefully insert the greased selector rail from the rear of the extension housing (Fig. F:31).

The selector boss must be fitted with the hole for the retaining pin towards the front of the gearbox. Secure the selector boss to the selector rail with the spring pin (Fig. F:32).

38. Install the lock plate fulcrum pin, and fit a new blanking plug coated with sealing compound to the aperture in the gearbox casing.

39. Install the detent plunger and spring in the bore in the side of the gearbox, and fit the retaining screw after coating the threads with sealing compound.

40. Fit the blanking plug, (coated with sealing compound) to the rear end of the extension housing (Fig. F:34). Fit the top cover to the gearbox, using a new gasket, and tighten the retaining bolts to their specified torque. The cover must be fitted with the vents facing rearwards.

41. Place a new gasket on the gearbox front face, and secure the clutch housing to the gearbox case. Tighten the retaining bolts to their specified torque.

42. Install the clutch release lever in the housing, and fit the clutch release bearing with the grooves engaged on the lever lugs.

OVERHAUL - (Type 'B')

Dismantling

1. If not already drained, remove the drain plug, and drain out the gearbox lubricant.

2. Remove the clutch release bearing and release arm. Remove the retaining bolts, and detach the clutch housing and gasket from the gearbox front face.

3. Remove the cover plate from the top of the gearbox.

4. Prise the blanking plug from the rear of the extension housing.

5. Remove the detent spring retaining screw from the right-hand side of the gearbox casing (Fig. F:35). Using a suitable punch, drive out the spring pin securing the selector boss to the selector rail (Fig. F:36).

Ensure that the spring does not foul any of the mainshaft components while being punched out. If necessary, move the position of the 1st/2nd synchroniser hub to suit.

6. Withdraw the selector rail from the rear, taking care not to let the selector boss and "C" cam drop into the gearbox casing.

7. Move the 1st/2nd and 3rd/4th gear synchroniser sleeves to their formost positions, and lift out the selector forks. If necessary, separate the selector forks from one another by tapping out the spring pin, and withdrawing the relay arm (Fig. F:37).

8. Remove the selector rail detent ball and spring from their bore in the gearbox casing.

9. Remove the oil seal from the rear of the extension housing, using tool No. 7657, and adaptor Tool No. P.7657-4. Fit the adaptor to the main tool, screw the assembly into the oil seal, and tighten the centre-bolt to extract the seal (Fig. F:38).

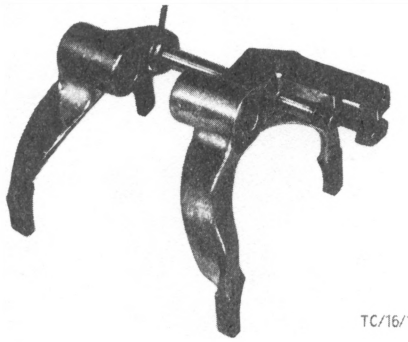


Fig. F:37 Selector forks and relay arm - Type 'B'

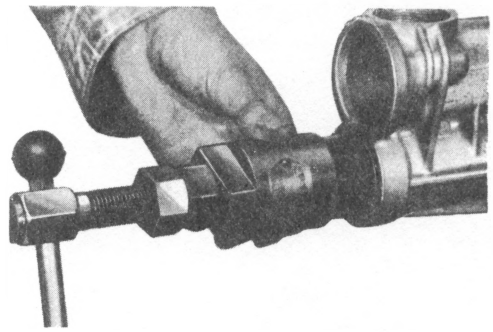


Fig. F:38 Removing extension housing oil seal - Type 'B'

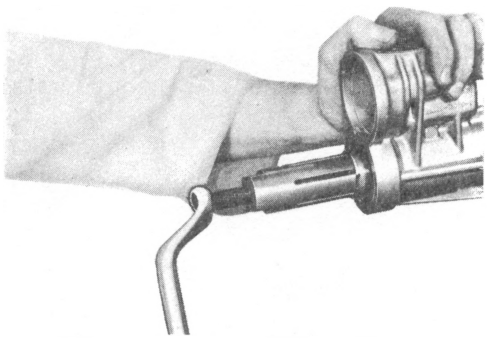


Fig. F:39 Removing extension housing bush - Type 'B'

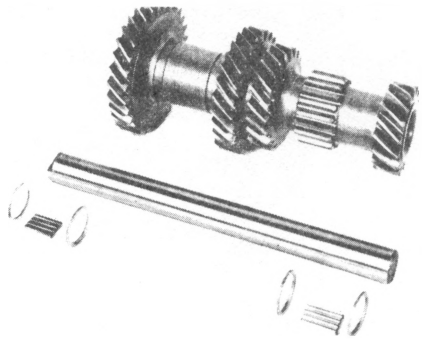
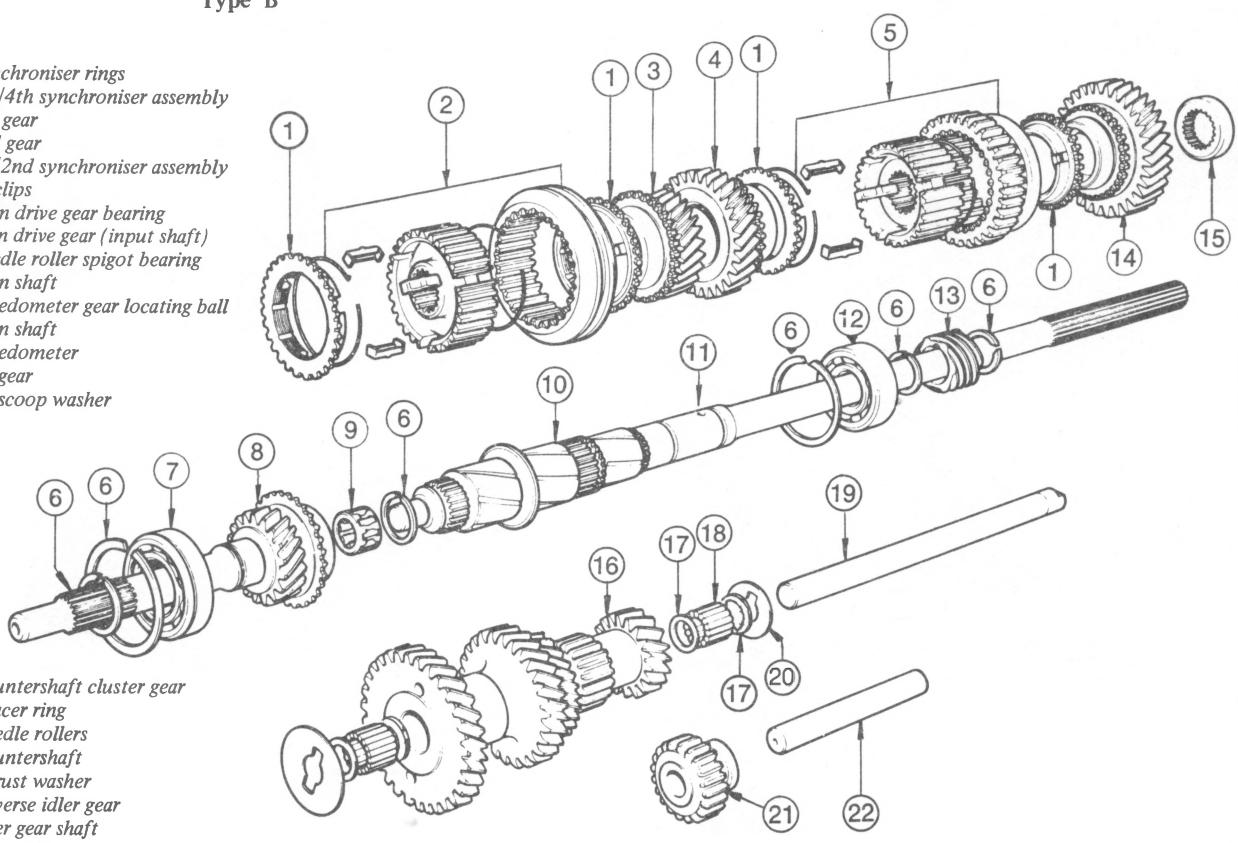


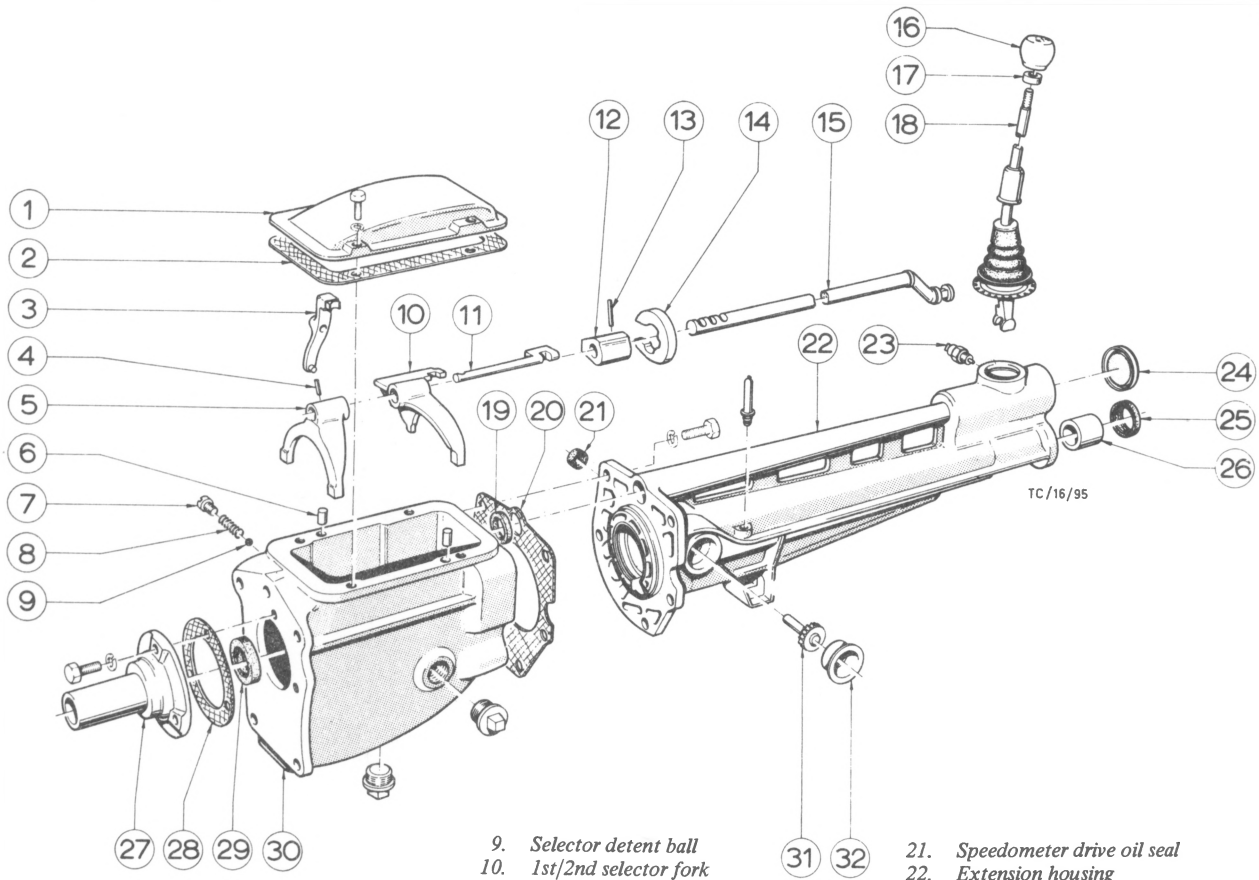
Fig. F:40 Countershaft gear assembly - Type 'B'

1. *Synchroniser rings*
2. *3rd/4th synchroniser assembly*
3. *3rd gear*
4. *2nd gear*
5. *1st/2nd synchroniser assembly*
6. *Circlips*
7. *Main drive gear bearing*
8. *Main drive gear (input shaft)*
9. *Needle roller spigot bearing*
10. *Main shaft*
11. *Speedometer gear locating ball*
12. *Main shaft*
13. *Speedometer*
14. *1st gear*
15. *Oil scoop washer*



16. *Countershaft cluster gear*
17. *Spacer ring*
18. *Needle rollers*
19. *Countershaft*
20. *Thrust washer*
21. *Reverse idler gear*
22. *Idler gear shaft*

Fig. F:41 Exploded view of gearbox internals - Type "B"



1. *Top cover plate*
2. *Gasket*
3. *Reverse relay arm*
4. *Retaining pin*
5. *3rd/4th selector fork*
6. *Locating pin*
7. *Detent retaining spring*
8. *Detent spring*
9. *Selector detent ball*
10. *1st/2nd selector fork*
11. *Selector fork relay arm*
12. *Selector boss*
13. *Retaining pin*
14. *'C' cam lock plate*
15. *Selector rail*
16. *Gear knob*
17. *Lock nut*
18. *Gear lever assembly*
19. *Selector rail oil seal*
20. *Gasket*
21. *Speedometer drive oil seal*
22. *Extension housing*
23. *Reverse lamp switch*
24. *Blanking plug*
25. *Oil seal*
26. *Bushing*
27. *Guide sleeve*
28. *Gasket*
29. *Oil seal*
30. *Gearbox case*
31. *Speedometer drive gear*
32. *Drive gear retainer*

Fig. F:42 Exploded view of gearbox casing - Type 'B'

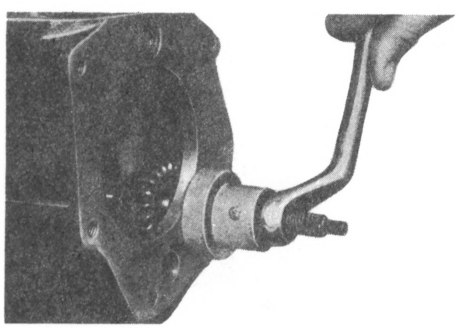


Fig. F:43 Withdrawing reverse idler shaft - Type 'B'

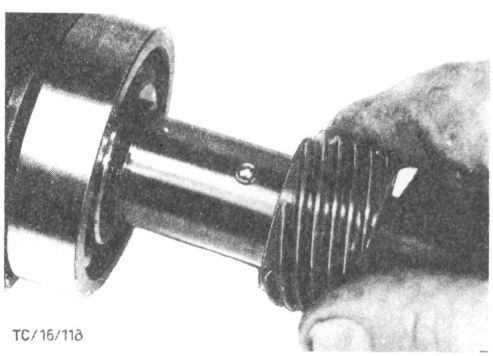


Fig. F:44 Speedometer drive gear and locating ball - Type 'B'

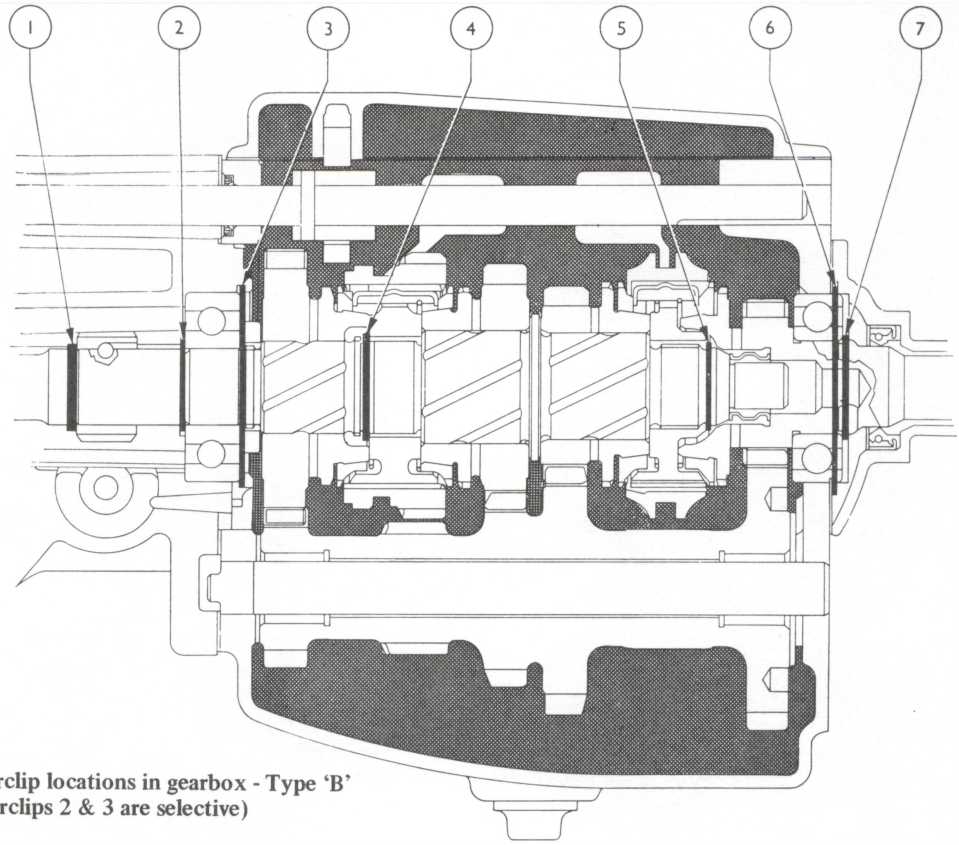


Fig. F:45 Circlip locations in gearbox - Type 'B'
(Circlips 2 & 3 are selective)

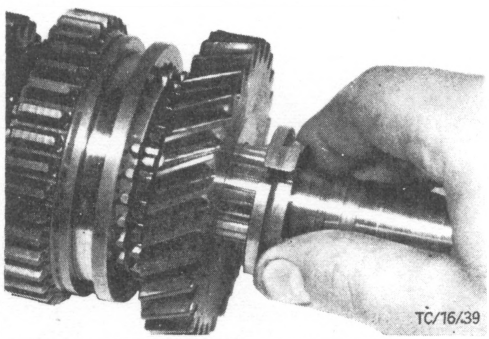


Fig. F:46 Location of oil scoop washer at 1st gear - Type 'B'

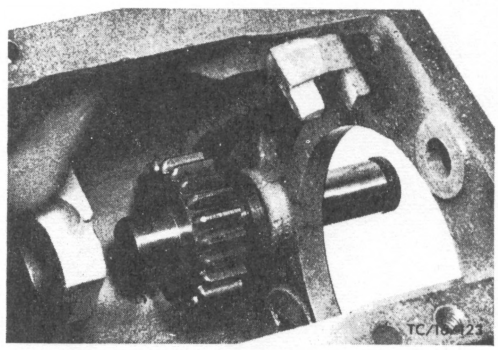


Fig. F:47 Reverse idler gear installation - Type 'B'

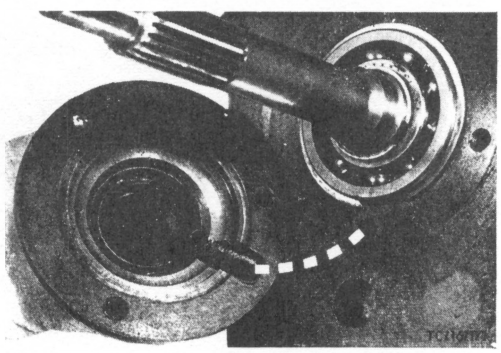


Fig. F:48 Main bearing retainer and oil hole - Type 'B'

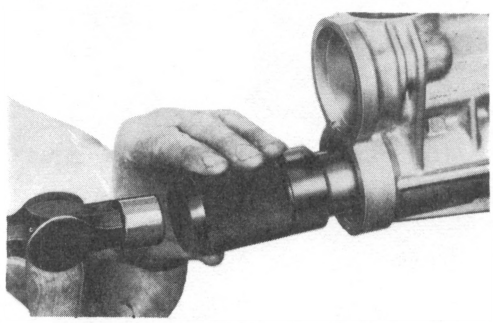


Fig. F:49 Installing extension housing bush - Type 'B'

10. Withdraw the extension housing bush, using bush remover, Tool No. P7149 (Fig. F:39)

11. Remove the bolts securing the extension housing to the gearbox casing. Tap the housing slightly rearwards, and rotate it so that the cut-out in the housing flange aligns with the countershaft.

12. Using a brass drift, tap the countershaft rearwards, until it is just clear of the front of the gearbox. Push the countershaft out of the gearbox, using a dummy countershaft (e.g. Tool No. 7113).

13. The countershaft cluster gear will drop to the bottom of the gearbox allowing the extension housing and mainshaft assembly to be withdrawn. Push the 3rd/4th gear synchroniser sleeve lightly forwards, to provide clearance between the sleeve and the countershaft cluster gear. If necessary lever the selector rail oil seal out of the bore in the gearbox casing with a screwdriver.

14. Remove the retaining plug from the extension housing, and withdraw the speedometer drive gear.

15. Remove the circlip retaining the mainshaft bearing in the extension housing (Fig. F:10) and tap the mainshaft assembly out of the housing, using a hide mallet.

If necessary, lever the speedometer drive oil seal out of the extension housing, with a screwdriver.

16. Remove the retaining bolts, and detach the main drive gear bearing retainer and gasket from the gearbox front face.

17. Remove the oil seal from the bearing retainer, with a screwdriver.

18. Remove the synchroniser ring from the main drive gear, and extract the mainshaft spigot bearing from the recess in the gear.

19. Remove the large circlip from the maindrive gear bearing, then using a suitable copper drift, tap the bearing out of the gearbox to the rear.

Only tap against the outer race of the bearing.

20. Remove the circlip securing the bearing on the main drive gear shaft, and press the bearing off the drive gear shaft.

21. Lift the countershaft gear and the two thrust washers out of the gearbox.

22. Withdraw the dummy shaft from the cluster gear and remove the needle rollers and spacer rings from each end of the cluster gear (Fig. F:40).

23. Using extractor, Tool No. P7043, withdraw the reverse idler shaft (Fig. F:43). Should this tool not be available, locate a nut, flat washer and sleeve on a 5/16th in. 24 UNF bolt, screw the bolt into the reverse idler shaft, and tighten the nut to withdraw the shaft.

24. Remove the reverse idler gear. Slide the reverse relay lever off the fulcrum pin on the gearbox casing, but do NOT remove the pin.

25. Remove the circlips securing the 3rd/4th gear synchroniser hub on the front end of the mainshaft, and press the mainshaft out of the 3rd/4th synchroniser hub and the 3rd gear ring.

26. Support the mainshaft from beneath to prevent it dropping. Pull the synchroniser sleeve off the hub, and withdraw the blocker bars and springs.

27. Remove the circlip from the rear end of the mainshaft, and withdraw the speedometer drive gear and locating ball (Fig. F:44).

28. Remove the circlip retaining the bearing on the mainshaft, and press the 1st gear, oil scooper ring and mainshaft bearing off the mainshaft.

29. Remove the circlip retaining the 1st/2nd gear circlip on the mainshaft, and press gear and 1st/2nd gear synchroniser assembly off the mainshaft. Dismantle the synchroniser assembly.

Reassembly

Before installation the threads of all bolts and screws exposed to oil in the gearbox should be coated with suitable sealer.

NOTE: Use only new circlips when reassembling (Fig. F:45).

1. Assemble the 1st/2nd gear synchroniser unit, by sliding the synchroniser sleeve onto its hub with the mating marsk on the hub and sleeve aligned.

2. Locate a blocker bar in each of three slots cut in the hub. Fit a blocker spring in one end of the hub under the blocker bars, with the hooked end of the spring located in the "U" section of one of the other blocker bars. Fit the other blocker spring to the opposite face of the hub, and locate the hooked end in the same blocker bar as the spring just fitted.

When viewed directly from their respective ends of the synchroniser unit, both springs should be located so that their direction of rotation from the hooked end is the same (Fig. F:17).

3. Slide the 2nd gear onto the rear of the mainshaft, with the dog teeth facing rearwards, and fit a synchroniser ring on the cone of the gear.

4. Slide the 1st/2nd gear synchroniser unit onto the shaft, (selector fork groove on the sleeve towards the rear of the mainshaft) and press the synchroniser hub fully home on the mainshaft. Secure the assembly on the mainshaft with a new circlip.

5. Fit the synchroniser ring on the cone of the 1st gear, and slide the gear onto the mainshaft from the rear.

6. Fit the oil scoop washer against the 1st gear, with the broad face of the washer TOWARDS the gear (Fig. F:46).

7. Determine the required thickness of mainshaft bearing to extension housing circlip, in the same manner as described for the TYPE 'A' gearbox. When fitted, the new circlip must have NO end-float.

8. Slide the selected circlip loosely onto the mainshaft, fit the mainshaft bearing, and press the bearing fully into position.

9. Secure the bearing on the mainshaft with a new circlip. Select the circlip to suit the groove so that no end-float exists (Fig. F:24).

10. Turn the mainshaft so that the hole for the speedometer drive gear is uppermost, fit the ball and slide the speedometer drive gear into position (Fig. F:44), Secure the drive gear with a new circlip.

11. Slide the 3rd gear onto the mainshaft from the front and place a synchroniser ring on the gear cone.

12. Assemble the 3rd/4th gear synchroniser assembly, in the same manner as described for the 1st/2nd gear synchroniser. Press the synchroniser assembly onto the mainshaft with the broad shoulder of the hub facing rearwards, and secure with a new circlip.

13. Fit the reverse relay arm onto the fulcrum pin. Fit reverse idler gear to the relay arm, (engagement groove on the gear boss towards the rear (Fig. F:47). Tap the idler shaft into the casing and through the gear, using a copper mallet.

14. Insert a dummy countershaft, Tool No. 7113, into the cluster gear, and pack the space between the shaft and bore with grease.

15. Place one of the spacer rings over the dummy shaft, and push it into the end of the gear bore. Grease the needle rollers, and assemble them in the recess.

16. Fit the second spacer ring to the ends of the bearing needles. Assemble the needle rollers in the other end of the gear (Fig. F:40).

17. Grease the two thrust washers, and position one at each end of the gear. Ensure that they are correctly located in the gear recess.

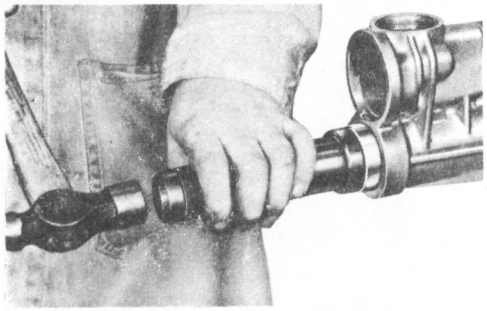


Fig. F:50 Installing extension housing oil seal - Type 'B'

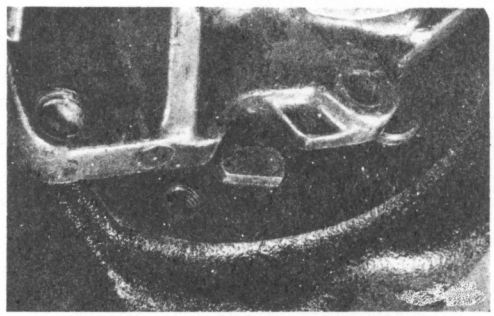


Fig. F:51 Location of flats on rear of countershaft - Type 'B'

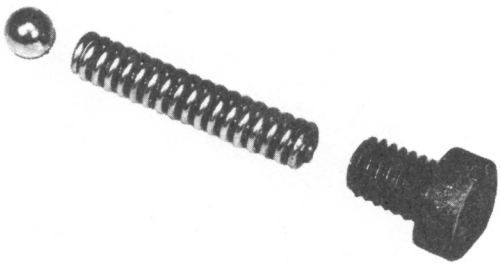
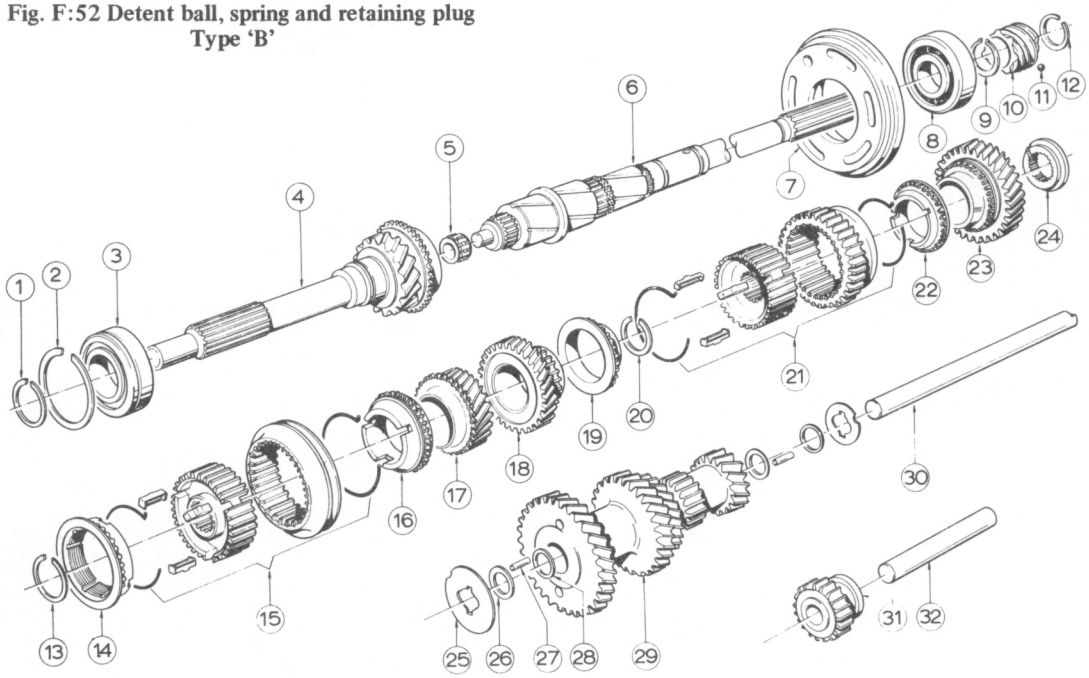


Fig. F:52 Detent ball, spring and retaining plug Type 'B'



1. *Circlip*
2. *Circlip*
3. *Main drive gear bearing*
4. *Main drive gear (input shaft)*
5. *Needle spigot bearing*
6. *Mainshaft*
7. *Intermediate bearing plate*
8. *Mainshaft bearing*
9. *Circlip*
10. *Speedometer drive gear*
11. *Drive gear locating ball*
12. *Circlip*
13. *Circlip*
14. *Synchroniser ring (4th gear)*
15. *3rd/4th synchroniser assembly*
16. *Synchroniser ring (3rd gear)*
17. *3rd gear*
18. *2nd gear*
19. *Synchroniser ring (2nd gear)*
20. *Circlip*
21. *1st/2nd synchroniser assembly*
22. *Synchroniser ring (1st gear)*
23. *1st gear*
24. *Oil scoop washer*
25. *Thrust washer*
26. *Spacer ring (outer)*
27. *Needle rollers*
28. *Spacer ring (inner)*
29. *Countershaft cluster gear*
30. *Countershaft*
31. *Reverse idler gear*
32. *Idler gear shaft*

Fig. F:53 Exploded view of gearbox internals - Type 'C'

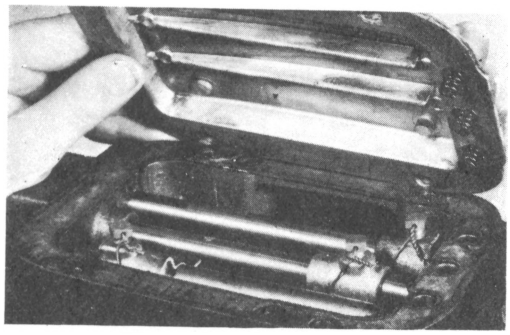


Fig. F:54 Top cover plate and detent springs - Type 'B'

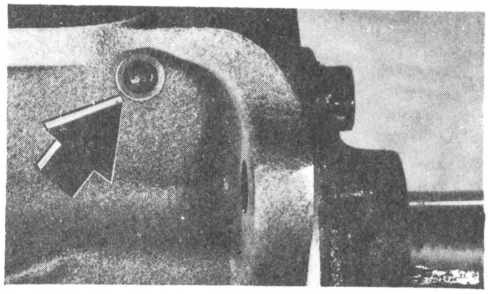
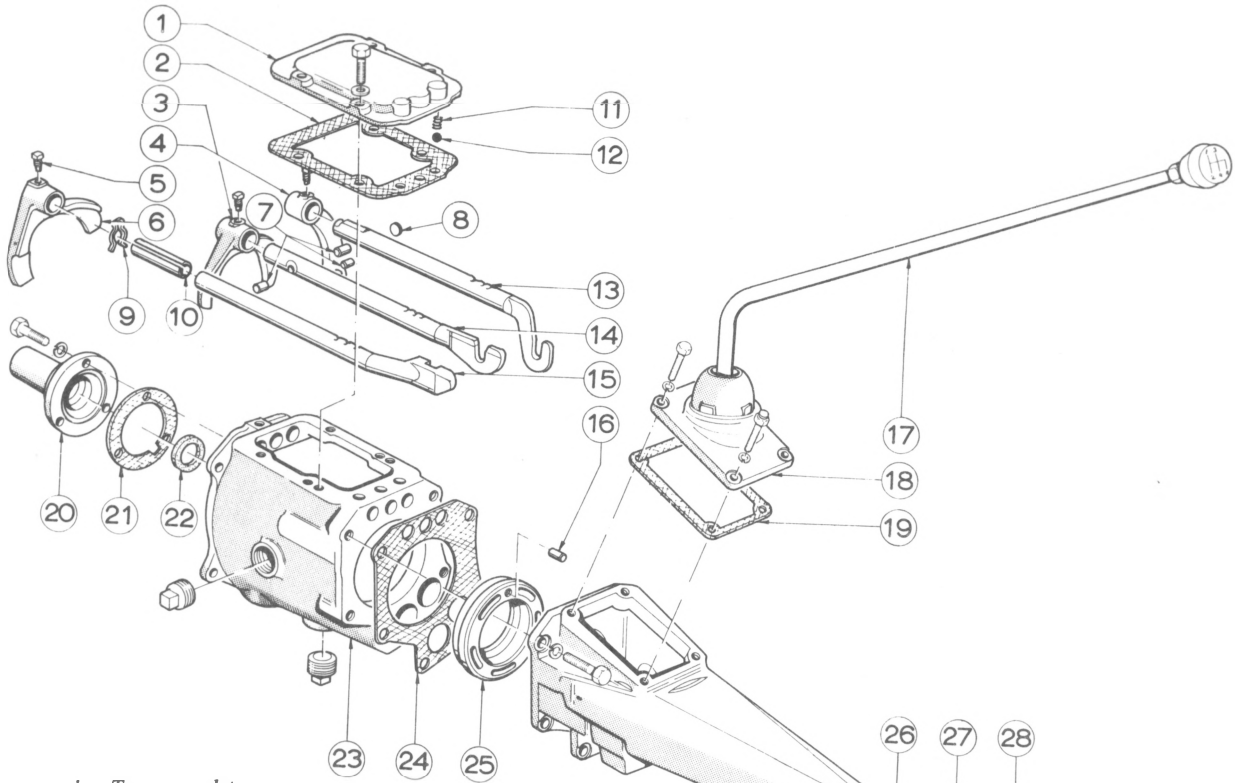


Fig. F:55 Blanking plug at interlock plunger bore - Type 'C'



1. *Top cover plate*
2. *Gasket*
3. *1st/2nd selector fork*
4. *Reverse relay arm*
5. *Fork fixing bolt*
6. *3rd/4th selector fork*
7. *Interlock plungers*
8. *Blanking plug*
9. *Sleeve retaining clip*
10. *Spacer sleeve*
11. *Detent springs*
12. *Selector detent balls*
13. *Reverse selector rail*
14. *1st/2nd selector rail*
15. *3rd/4th selector rail*
16. *Plate locating pin*
17. *Gear lever*
18. *Gear lever turret*
19. *Gasket*
20. *Guide sleeve*
21. *Gasket*
22. *Oil seal*
23. *Gearbox case*
24. *Gasket*
25. *Intermediate bearing plate*
26. *Extension housing*
27. *Bushing*
28. *Oil seal*

Fig. F:56 Exploded view of gearbox case - Type 'C'

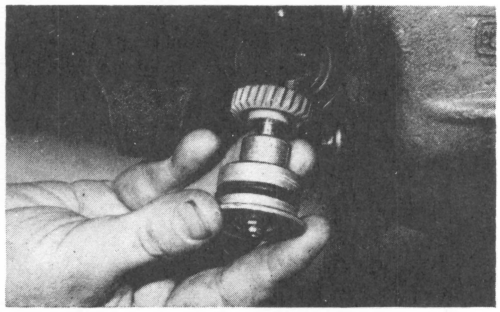


Fig. F:57 Removing speedometer drive pinion - Type 'C'

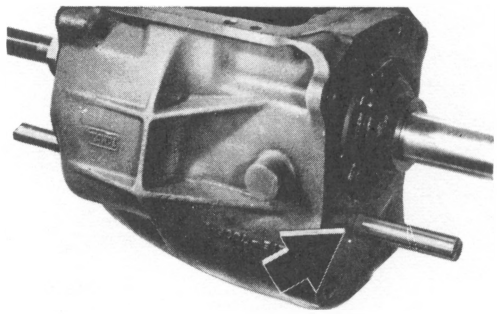


Fig. F:58 Driving out countershaft with dummy shaft - Type 'C'

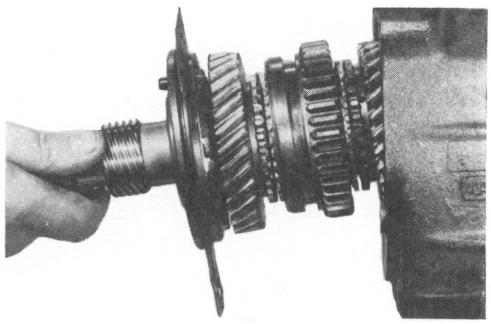


Fig. F:59 Withdrawing the mainshaft assembly - Type 'C'

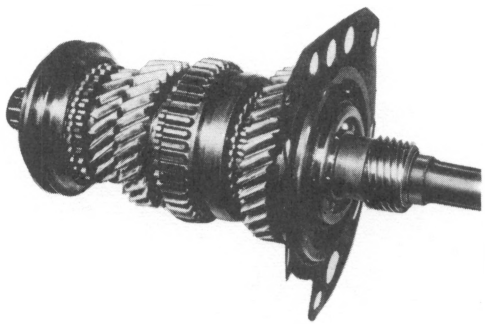


Fig. F:60 Gasket fitted on intermediate bearing plate - Type 'C'

Fig. F:61 Location of flats on countershaft and reverse idler shaft - Type 'C'

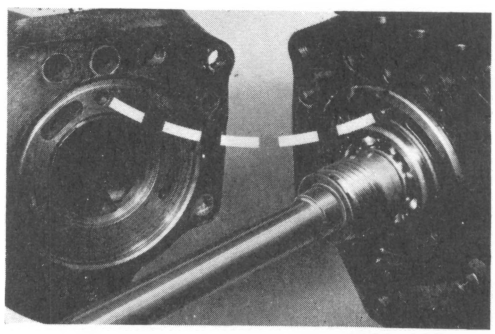


Fig. F:62 Intermediate bearing plate locating stud - Type 'C'

18. Carefully lower the cluster gear assembly into position in the gearbox. Ensure that the thrust washer "ears" are located on each side of the location boss.

19. Press the bearing fully home on the main drive gear shaft.

NOTE: The circlip groove on the outer race of the bearing should be towards the front of the shaft. Secure the bearing on the shaft with a new circlip.

20. Using a copper drift and tapping only on the OUTER race of the bearing, install the main drive gear in the gearbox case from the REAR. Tap the bearing home until the circlip groove on its periphery is clear of the gearbox face. Take care during this operation to avoid damaging the dog teeth on the countershaft cluster gear.

21. Fit the large circlip to the bearing outer race.

22. Press a new oil seal into the bearing retainer, with the sealing lip positioned so that it will face the gearbox.

23. Cover the main drive gear splines with masking tape, to prevent damage to the retainer oil seal.

24. Lightly grease the sealing surface of the oil seal, and slide the retainer into position with a new gasket. Ensure that the gasket and retainer are correctly positioned with regard to the lubrication hole (Fig. F:48). Fit the retaining bolts, and tighten to their specified torque. Remove the masking tape.

25. Press a new bush into the rear of the extension housing, using Tool No. P.7150 (Fig. F:49). Ensure that the recess in the bush is aligned with the oil return groove (Fig. F:28).

26. Install a new oil seal in the housing, using Tool No. P.7095 to drive it squarely into position (Fig. F:50).

27. Press the mainshaft into the extension housing and secure with the circlip which was loosely fitted earlier (Fig. F:10).

It will facilitate centralising of the mainshaft if the propshaft yoke is inserted into the rear of the extension housing.

28. Install a new speedometer drive oil seal in the extension housing, and fit the speedometer drive gear. Secure in position with a new retainer plug coated with sealing compound.

29. Install a new selector rail oil seal in the rear face of the gearbox casing.

30. Oil the mainshaft needle roller spigot bearing, and fit it in the centre recess of the main drive gear. Fit the synchroniser ring on the cone of the 4th gear.

31. Coat a new extension housing gasket with sealing compound, and place it on the extension housing. Pass the mainshaft assembly into the gearbox, and slide it into position, after pulling the 3rd/4th gear synchroniser sleeve slightly forwards to provide clearance between the sleeve and the countershaft cluster gear.

NOTE: Take care, when entering the front spigot into the bearing in the main drive gear, to avoid dislodging the needle rollers.

32. Turn the extension housing until the cut-away on the housing aligns with the countershaft aperture in the rear face of the gearbox. Ensure that both the countershaft cluster gear thrust washers are properly aligned, and are not displaced during this operation.

33. Insert the countershaft from the rear, and keeping it in permanent contact with the dummy shaft, tap if fully home, using a hide or copper mallet. Retain the dummy shaft. Ensure that the flats on the rear of the shaft are positioned horizontally so that they will fit into the locking recess in the extension housing (Fig. F:51).

34. Rotate the extension housing until the bolt holes align, then push the housing fully home onto the gearbox case.

35. Coat the threads of the retaining bolts with sealing compound, fit the bolts and tighten to their specified torque.

36. Assemble the 1st/2nd gear and 3rd/4th gear selector forks on the relay arm, and secure with a new pin (Fig. F:37).

37. Push the 1st/2nd and 3rd/4th gear synchroniser sleeves rearwards, and fit the selector forks on the sleeves. Move the sleeves back into the neutral position and lightly grease the selector rail oil seal.

38. Position the selector boss and "C" cam in line with the selector rail bore, and carefully insert the selector rail from the rear. Secure the selector boss to the rail with a new spring pin.

39. Install the detent ball and spring in the bore in the side of the gearbox, and fit the retaining screw after coating the threads with sealing compound.

40. Fit the blanking plug, again coated with sealing compound, to the rear end of the extension housing (Fig. F:34). Fit the top cover to the gearbox, using a new gasket, and tighten the retaining bolts to their specified torques.

41. Place a new gasket on the gearbox front face, and secure the clutch housing to the gearbox case. Tighten the retaining bolts to their specified torques.

42. Install the clutch release lever in the housing, and fit the clutch release bearing with the grooves engaged on the lever lugs.

Overhaul - (Type 'C')

Dismantling

The overhaul procedure is similar to that described for the 'Type B' gearbox. However, the following differences apply:-

1. Remove the gear lever turret from the extension housing.

2. Remove the cover plate from the top of the gearbox.

NOTE: Lift the cover plate off carefully, as the selector shaft detent springs are located in its underside, and may be displaced when the cover is removed (Fig. F:54).

3. Invert the gearbox to remove the three detent balls from their locations in the rear of the gearbox top face.

4. With the gearbox in neutral remove the locking wire from the selector fork fixing bolts, and unscrew the three square-head taper bolts.

5. Remove the retainer clip from the 3rd/4th (L.H.) selector rail, withdraw the selector rail, and lift out the spacer sleeve.

6. Withdraw the central 1st/2nd selector rail, and remove the floating interlock pin from the cross drilling at the forward end of the shaft.

7. Withdraw the reverse (R.H.) selector rail. Lift out the selector rail. Lift out the selector forks.

8. Remove the blanking plug at the R.H. side of the gearbox casing (Fig. F:55), and collect the two interlock plungers located in the bore.

9. Remove the extension housing oil seal and bush, as described for the 'Type B' gearbox.

10. Extract the speedometer drive from the side of the extension housing, using two screwdrivers arranged opposite each other. Remove the O-ring from its seat in the drive bearing (Fig. F:57).

11. Remove the bolts securing the extension housing, and detach the housing from the gearbox casing.

12. Using a suitable drift, tap the countershaft rearwards, until it is just clear of the front of the gearbox, then insert a dummy countershaft Tool No. 7113, and push the countershaft completely out of the gearbox (Fig. F:58).

The countershaft cluster gear will now drop to the bottom of the gearbox, allowing the mainshaft assembly to be withdrawn rearwards out of the gearbox case (Fig. F:59).

13. Remove the reverse idler shaft and gear, as described for the 'Type B' gearbox, and note that no reverse relay lever is fitted in this case.

14. The mainshaft assembly is dismantled in the same manner as described for the "Type B" gearbox.

NOTE: In intermediate bearing plate locates the mainshaft bearing in the rear face of the gearbox casing instead of the peripheral circlip used

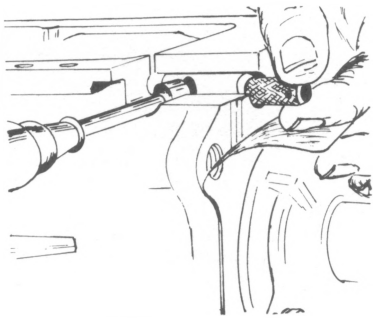


Fig. F:63 Installing selector shaft interlock plungers - Type 'C'

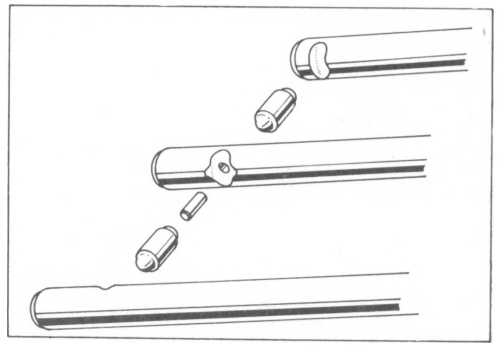


Fig. F:64 Selector shaft interlock plungers - Type 'C'

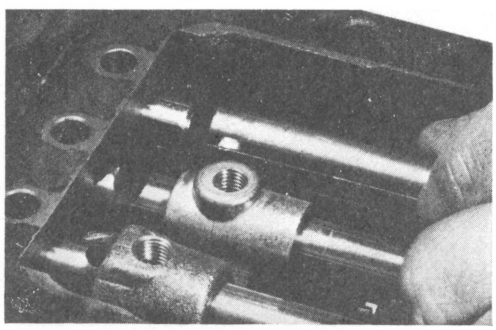


Fig. F:65 Fitting 3rd/4th selector rail spacer sleeve - Type 'C'

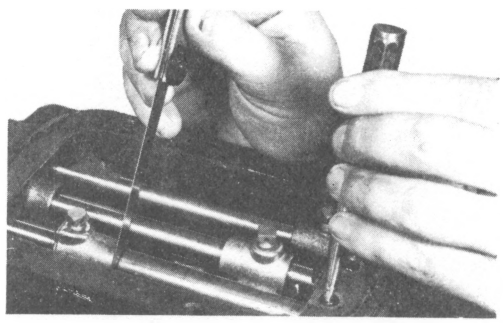


Fig. F:66 Measuring spacer sleeve end-float - Type 'C'

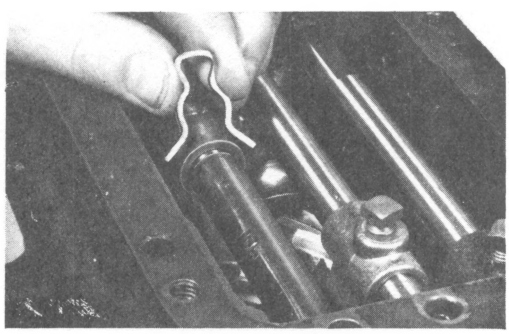


Fig. F:67 Fitting 3rd/4th selector rail retainer clip - Type 'C'

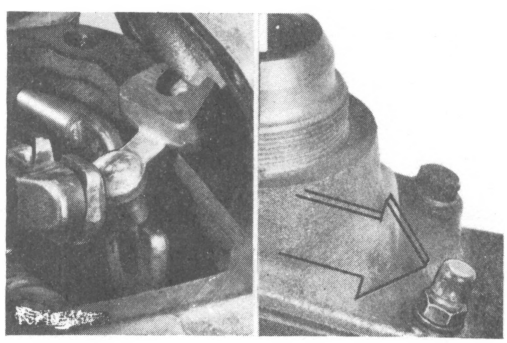


Fig. F:68 Reverse relay arm (left), turret breather bolt (right) - Type 'C'

on the 'Type B'. The plate can only be removed after the bearing is withdrawn from the mainshaft.

Reassembly

1. Assemble the 2nd gear, 1st/2nd gear synchroniser unit, 1st gear and oil scoop washer on the rear end of the mainshaft as described for the 'Type B' gearbox.
2. Position the intermediate bearing plate on the mainshaft with the dowel hole to the rear and fit the mainshaft bearing.
3. Draw the bearing plate slightly to the rear to fit over the bearing, then press the bearing fully into position (bearing only on the inner race). Complete the assembly, as described for the 'Type B' mainshaft assembly.
4. Install a new bush and oil seal in the extension housing, as described for the 'Type B' gearbox.
5. Oil the mainshaft needle roller spigot bearing, and fit the bearing in the centre recess of the main drive gear.
6. Fit the 4th gear synchroniser ring on the cone of the main drive gear.
7. Coat a new extension housing gasket with sealing compound and position it on the periphery of the intermediate bearing plate (Fig. F:60).
8. Pass the mainshaft assembly into the gearbox, and slide it into position.

Take care, when entering the front spigot into the bearing in the main drive gear, to avoid dislodging the needle rollers.

9. Lift the countershaft cluster gear into engagement with the mainshaft and main drive gear. Ensure that both the cluster gear thrust washers are properly aligned, and are not displaced during this operation.
10. Insert the countershaft from the rear, and keeping it in permanent contact with the dummy shaft, tap it fully home, using a hide or copper mallet. Retain the dummy shaft. Ensure that the flats on the rear end of the countershaft and the reverse idler shaft are positioned as shown in Fig. F:61 so that they will correctly engage the locking recess in the extension housing.
11. Ensure that the locating pin in the intermediate bearing plate is in line with the centre selector rail hole in the gearbox case (Fig. F:62). Ensure that the extension housing gasket is correctly positioned on the gearbox rear face.
12. Slide the extension housing into position over the mainshaft, engage the locating pin in the corresponding bore in the extension housing, and push the housing fully home onto the gearbox casing.
13. Coat the threads of the retaining bolts with sealing compound, fit the bolts, and tighten to their specified torque.
14. Install a new O-ring on the speedometer drive bearing and fit the bearing and driven gear into the extension housing. Tap the bearing fully home in the housing once the gears are engaged.
15. Using plunger guide, Tool No. P7093, inserted into the reverse selector rail hole from the front (Fig. F:63) push one of the interlock plungers into the bore in the side of the gearbox and through the tool, until it is located in the first cross-drilling.
16. Remove the guide tool, and position it in the centre selector rail hole. Again push the plunger through the tool, until it locates in the second cross-drilling in the casing.
17. Locate the second interlock plunger in the first cross-drilling in the same manner.
18. Coat a new blanking plug with sealer, and fit it to the interlock bore (Fig. F:55).
19. With the gearbox in neutral, fit the selector forks to their respective synchroniser sleeves. Pass the reverse selector rail throught the R.H. bore in the gearbox casing and through the reverse selector fork from the rear.
20. Insert the 1st/2nd selector rail through the centre bore and selector fork, install the floating interlock pin in the cross-drilling at the forward end of the rail and push the rail fully home.
21. Fit the 3rd/4th selector rail through the L.H. bore, position the spacer sleeve in the gearbox and pass the rail through the sleeve and selector fork (Fig. F:65).
22. Ensure that all three rails are pushed fully home, then fit the selector fork fixing bolts. Tighten the bolts to their specified torque, and secure with soft iron locking wire.
23. Fit the three detent balls in their respective bores in the gearbox top face. Select 3rd gear and press down the 3rd/4th gear detent ball, using a suitable drift.
24. Measure the end-float between the spacer sleeve and the 3rd/4th gear selector fork (Fig. F:66). Note the figure obtained, and select the appropriate thickness of retainer clip to give zero end-float (Fig. F:67).

NOTE: Twelve thickness grades of clips are available.

25. Check that all gears can be selected before fitting the top cover. Coat the three detent springs with grease, and install them in the gearbox cover plate.
26. Fit the cover plate to the gearbox, using a new gasket, and tighten the retaining bolts to their specified torque.
27. Using a new gasket, fit the gear lever turret on the extension housing. Ensure that the reverse relay arm on the turret correctly engages with the reverse selector rail (Fig. F:68).
28. Fit the turret retaining bolts and tighten to their specified torque.
29. Note that the rear L.H. bolt incorporates a breather, which should be inspected, to ensure it is free from dirt and sealer (Fig. F:68).

Technical Data

Gear Ratios	Type A	Type B	Type C
1st	3.65 : 1	2.97 : 1	3.54 : 1
2nd	1.97 : 1	2.01 : 1	2.40 : 1
3rd	1.37 : 1	1.43 : 1	1.41 : 1
Top	1.00 : 1	1.00 : 1	1.00 : 1
Reverse	3.66 : 1	3.32 : 1	3.96 : 1

Overhaul Data

Type A Gearbox

Countershaft gear end-float	0.15 - 0.45 mm (0.006 - 0.018 in)
Thrust washer thickness	1.55 - 1.60 mm (0.061 - 0.063 in)
Countershaft dia.	17.317 - 17.329 mm (0.6818 - 0.6823 in)

Type B Gearbox

Countershaft gear end-float	0.205 - 0.505 mm (0.008 - 0.020 in)
Countershaft dia.	17.317 - 17.329 mm (0.6818 - 0.6823 in)

Type C Gearbox

Countershaft gear end-float	0.205 - 0.505 mm (0.008 - 0.020 in)
Countershaft dia.	16.703 - 16.715 mm (0.6576 - 0.6581 in)

Automatic Transmission

GENERAL
EMERGENCY STARTING AND TOWING
CHECKING THE FLUID LEVEL
ADJUSTMENTS
TRANSMISSION REMOVAL AND INSTALLATION
TORQUE CONVERTER
TECHNICAL DATA

GENERAL

Automatic transmission is available, as an option, on all except 1300 cc models. The Borg Warner Type 35 transmission unit comprises a torque converter and a hydraulically controlled epicyclic gearbox with three forward ratios and one reverse. The torque converter provides an infinitely variable torque multiplication between 1.91 : 1 when starting from rest, and during maximum acceleration, and 1 : 1 when the engine and transmission input shaft speeds are approximately similar. The gear ratios in the transmission are selected automatically by a hydraulic control system. The control system and the torque converter are supplied with oil under pressure by a common oil pump, driven by the front section of the torque converter. The converter is attached to and driven by the engine crankshaft by means of a spring steel drive plate.

Manual control of the transmission is afforded by a floor-mounted selector lever, connected to the gearbox through a cable linkage. For reasons of safety, all selector positions except 'N' and 'D' are mechanically interlocked. Before the selector lever can be moved between the interlock positions, a spring-loaded push-button on the side of the lever 'T' handle must first be depressed.

The selector provides the following positions:-

P. Park. Transmission is locked, immobilising the car. Select only when car is stationary.

R. Reverse. Select only when car is stationary.

N. Neutral. Corresponds to the neutral position on a conventional gearbox.

D. Drive. Normal driving position. All gears engage automatically.

2. Second Range. 3rd gear locked out. Transmission changes automatically between 1 - 2 and 2 - 1. Engine braking obtained in 2nd gear. Do NOT select at speeds above 88 kph (55 mph), otherwise the engine will over-rev.

1. First Range. 1st gear held. Full engine braking provided. Do NOT select at speeds above 88 kph (55 mph).

A down-shift device, which operates on accelerator pedal depression, is also incorporated in the hydraulic control system. The down-shift valve in the transmission is connected through a cable linkage to the throttle control shaft.

Because of the specialised tools and knowledge required to service the automatic transmission, it is recommended that any adjustments or overhaul operations, other than those described in this section, be entrusted to an Authorised Dealer or Transmission Specialist.

EMERGENCY STARTING AND TOWING

Emergency starting, due to a flat battery, etc., CANNOT be achieved by a push-start or tow. Battery jumper leads may be used, but great care should be taken to ensure the leads are correctly connected. Connect the positive (+) terminals of the booster battery to the positive (+) terminal of the vehicle battery, and the negative (-) terminal to the negative (-) terminal. Attach the cables to the booster battery to reduce the possibilty of sparks near a charged battery.

The conditions for towing are dependent on whether the transmission is in running order or not. If the transmission is defective, either the rear wheels must be lifted clear of the road or the propshaft must be removed. If the propshaft is to be removed, seal off the rear end of the transmission to prevent the entry of dust, mud or water. If the transmission is operating satisfactorily, the vehicle may be towed with the selector lever in the 'N' position, after first checking that the fluid level is correct. Do NOT, however, exceed 48 kph (30 mph) or tow the car for a distance greater than 24 km (15 miles).

CHECKING THE FLUID LEVEL

1. Check the fluid level with the car standing on level ground and the gearbox at normal operating temperature.
2. Move the selector lever through all positions, then place it in 'P' and allow the engine to idle for two minutes.
3. The fluid level dipstick is located in the transmission filler tube, just forward of the engine compartment bulkhead. Clean all dirt from the dipstick cap and surrounding area, before removing the dipstick.
4. With the engine idling and the selector in 'P', withdraw the dipstick, wipe it on a clean non-fluffy rag or clean paper. Reinsert the dipstick FULLY, and withdraw again immediately. Check the fluid level indicated on the dipstick. If necessary, add fluid of the recommended type to bring the level up to the 'Full' mark. The difference between the 'Low' and 'Full' marks on the dipstick is 0,6 litres (1.0 Imp. Pt).

NOTE: Do NOT overfill the transmission, as this will cause the fluid to become aerated.

If for any reason it is necessary to check the fluid level with the transmission cold, the reading should be taken with the engine idling in 'P', as described above. However, in this case, the level should be approx. 9,5 mm (0.375 in) below the 'Full' mark, otherwise it will be too high at normal operating temperature when the fluid expands. The level should be rechecked when the gearbox is at normal running temperature.

NOTE: Periodic fluid changes are NOT required.

ADJUSTMENTS

Only the adjustments described below should be attempted. Any further adjustments (e.g. brake bands) should be entrusted to an Authorised Dealer or Transmission Specialist.

Selector Cable

1. Disconnect the selector cable from the operating arm on the transmission (Fig. G:3). Move the manual selector lever into the '1' position.
2. Pull the transmission operating arm into its rearmost position.
3. Slacken the adjuster nuts, and alter the position of the

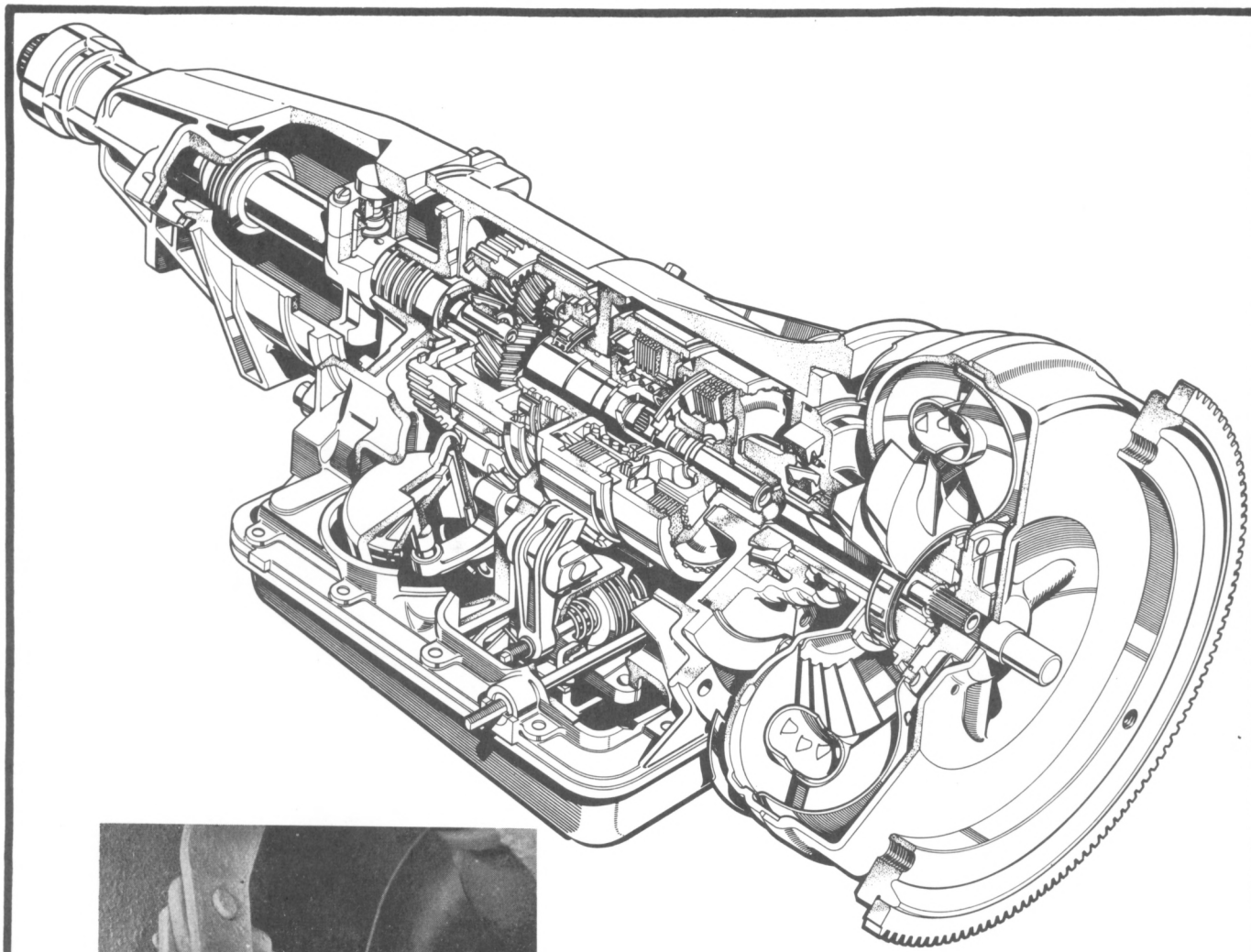


Fig. G:1 Cut-away view of automatic transmission

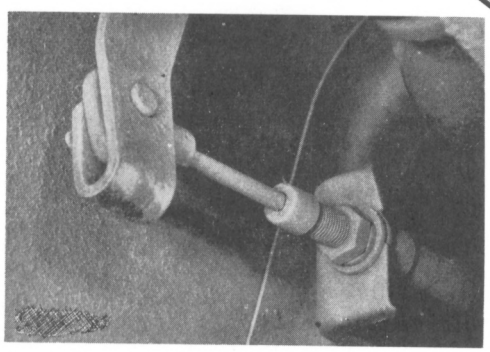


Fig. G:2 Selector cable connection at selector lever

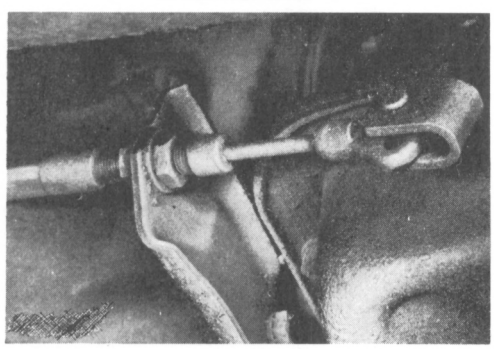


Fig. G:3 Selector cable connection at transmission operating arm

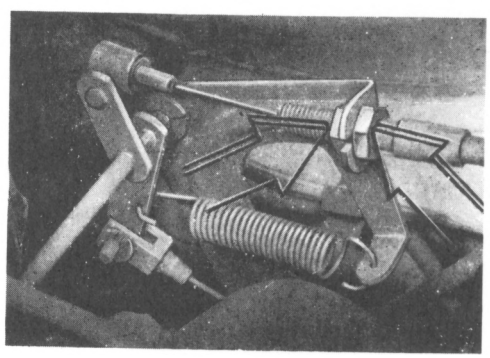


Fig. G:4 Downshift cable adjustment

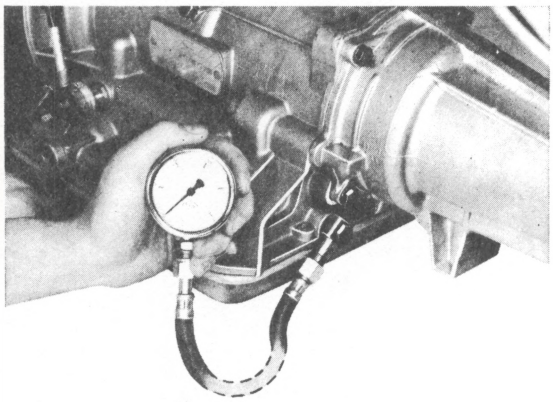


Fig. G:5 Checking transmission line pressure

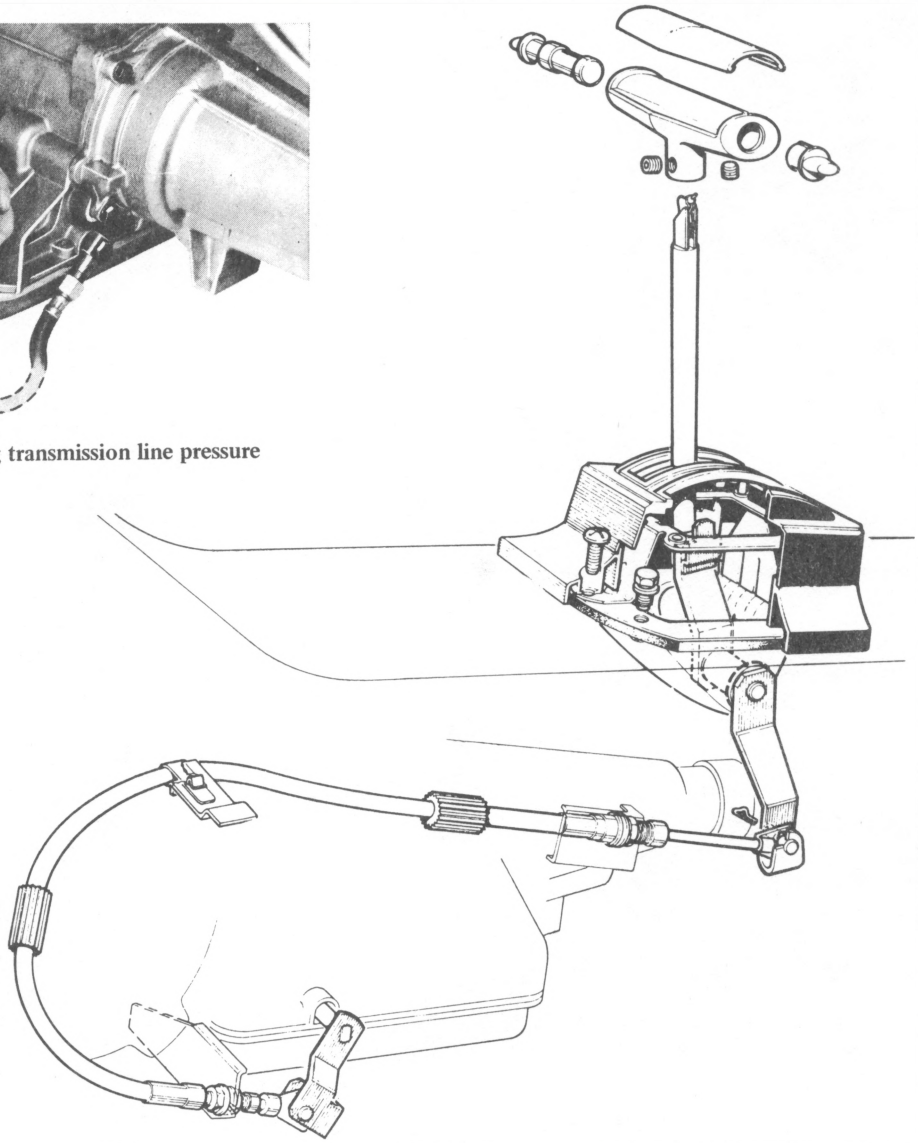


Fig. G:6 Selector lever and cable linkage

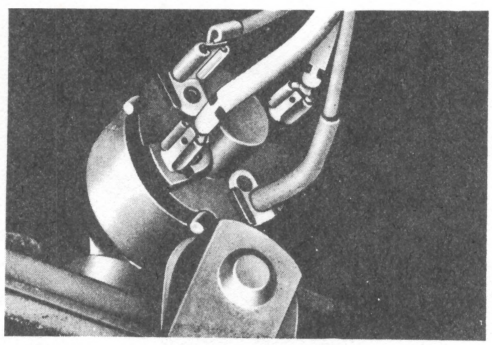


Fig. G:7 Starter inhibitor and reverse light switch

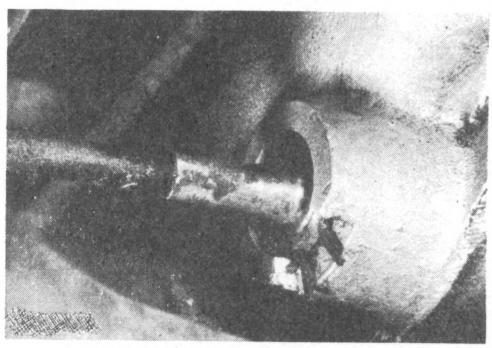


Fig. G:8 Speedometer cable retaining circlip

cable threaded sleeve in relation to the abutment bracket until the holes in the cable end and operating arm are aligned.

4. Reconnect the cable to the operating arm. The cable should be taut, but not stressed, when in position.

5. Secure the clevis pin with the spring clip. Tighten the adjuster nuts. Ensure that the spacers are in their correct positions. Check that all the selector positions can be engaged.

Downshift Valve Cable

1. Before attempting to adjust the downshift linkage, ensure that the throttle valve opens fully, and is not impeded in its operation by the accelerator pedal stop.

2. Check the fluid level as described previously in this section.

3. The engine and transmission must be at normal operating temperature when performing this adjustment. With the engine stopped, remove the blanking plug from the pressure line take-off point in the rear face of the transmission case, and connect a transmission line pressure gauge (Fig. G:5).

4. Connect an accurate tachometer to the engine.

5. Start the engine and set the idling speed to approx. 560 rev/min. Eliminate any free-play in the accelerator linkage.

6. Apply the foot and hand brake, move the selector lever into the 'D' position, then set the engine idling speed exactly to 500 rev/min.

7. Note the pressure gauge reading. This should be 3,52 - 4,57 atu (50 - 60 psi).

8. Increase the engine speed to 1,000 rev/min. and take a second pressure gauge reading. This should indicate a pressure rise of 1,05 - 1,41 atu. (15 - 20 psi) over the previous reading for 1600 cc and 2000 cc models, or an actual gauge reading of 5,62 - 7,03 atu. (80 - 100 psi) for 1600 GT models.

NOTE: Do NOT hold this increased engine speed for longer than 20 seconds.

9. If the indicated pressure or pressure rise is not within the specified range,slacken the adjuster nuts at the outer cable bracket on the engine compartment bulkhead and alter the position of the threaded sleeve in relation to the bracket (Fig. G:4).

10. Increase the effective length of the outer cable if the indicated pressure or pressure rise is low.

11. Conversely, if the pressure or pressure rise exceeds the specified limit, decrease the effective length of the outer cable.

12. Retest the line pressure after adjustment. When the correct setting is obtained retighten the cable adjuster nuts.

13. Reset the idle speed to specification. Stop the engine, disconnect the pressure gauge and refit the blanking plug to the take-off point. Take care not to over-tighten the plug in the aluminium threads of the transmission casing.

14. Remove the tachometer. Finally, road test the car and check the quality of the gear changes.

Starter Inhibitor Switch

1. When the starter inhibitor switch is functioning correctly the engine will only start with the selector lever in the 'P' or 'N' positions. If the engine will not start in the 'P' or 'N' selector positions, or if the starter motor operates in all selector positions, then the switch requires adjustment.

The reverse light should also operate only when the selector lever is in 'R'.

2. Before attempting to adjust the switch, check the adjustment of the selector cable, as described previously.

3. The combined starter inhibitor and reverse light switch is located on the L.H. side of the transmission case. The switch has four terminals; two large terminals for the reverse light switch, and two smaller terminals for the starter inhibitor switch (Fig. G:8).

4. Place the selector lever in the 'D' or '1' position. Suitably label the respective leads and disconnect them from the switch.

5. Slacken the switch locknut. Connect a small battery and test lamp across the reverse switch terminals.

6. Unscrew the switch fully from the transmission casing, then screw it in again until the test lamp just goes out. Mark the position of the switch.

7. Transfer the test lamp to the inhibitor switch terminal, then screw the switch in further until the test lamp just lights again. Mark this second position of the switch.

8. Unscrew the switch until it is midway between the two marked positions, and secure it with the locknut. Do NOT over-tighten the locknut; it need only be pinch tight. Reconnect the leads to the appropriate terminals on the switch.

9. Check that the switch functions as described above. If the switch still does not operate correctly, check the switch wiring and connections before replacing the switch.

TRANSMISSION - Removal

1. Disconnect the battery.

2. Remove the air cleaner.

3. Unscrew the adjuster nut from the end of the downshift cable. Remove the spring clip and clevis pin securing the downshift cable to the arm on the throttle control shaft and disconnect the cable from the arm on the abutment bracket (Fig. G:4).

4. Remove the upper bolts securing the converter housing to the engine.

5. Disconnect the starter motor leads. Remove the starter motor retaining bolts and withdraw the starter motor.

6. Raise the car and support on stands.

7. Disconnect the propshaft at the rear axle, after marking the flange alignment.

8. On models with split propshaft, unbolt the centre bearing from the underbody. Remove the propshaft.

9. Fit a dummy yoke or other suitable plug in the transmission extension housing, to prevent loss of fluid.

10. Disconnect the leads from the starter inhibitor and reverse light switch, noting the positions of the respective leads.

11. Remove the circlip and withdraw the speedometer cable from the transmission extension housing (Fig. G:9).

12. Detach the mounting bracket and down pipe from the exhaust manifold.

13. Remove the spring clip and clevis pin and disconnect the selector cable from the operating arm (Fig. G:3).

14. Unscrew the adjuster nut from the end of the outer cable, and disconnect the cable from its abutment bracket.

15. Detach the inspection cover from the bottom of the converter housing.

16. Remove the bolts securing the converter to the drive plate. These are accessible through the starter motor aperture. (Fig. G:10). Rotate the crankshaft, as necessary, to bring each bolt in turn in line with the aperture.

17. Place a jack under the transmission to support it and detach the support crossmember from the extension housing and the underbody.

18. Lower the jack sufficiently to allow the transmission filler tube and dipstick assembly to be removed.

19. Remove the remaining bolts securing the converter housing to the engine.

20. Insert a wooden block between the engine sump and the front crossmember, to prevent the engine dropping after transmission is removed (Fig. G:11).

21. Withdraw the transmission rearwards until it is clear of the engine, then lower it, and remove from under the car.

1. *Oil seal*
2. *Bearing bush*
3. *Extension housing*
4. *Gasket*
5. *Adjuster locknut*
6. *Rear band adjuster*
7. *Transmission casing*
8. *Tube sealing ring*
9. *Drive gear retainer*
10. *Speedometer driven gear*
11. *Filler tube*
12. *Dipstick*
13. *Sealing ring*
14. *Circlip*
15. *Starter inhibitor and reverse light switch*
16. *Switch locknut*
17. *Gasket*
18. *Oil pan*

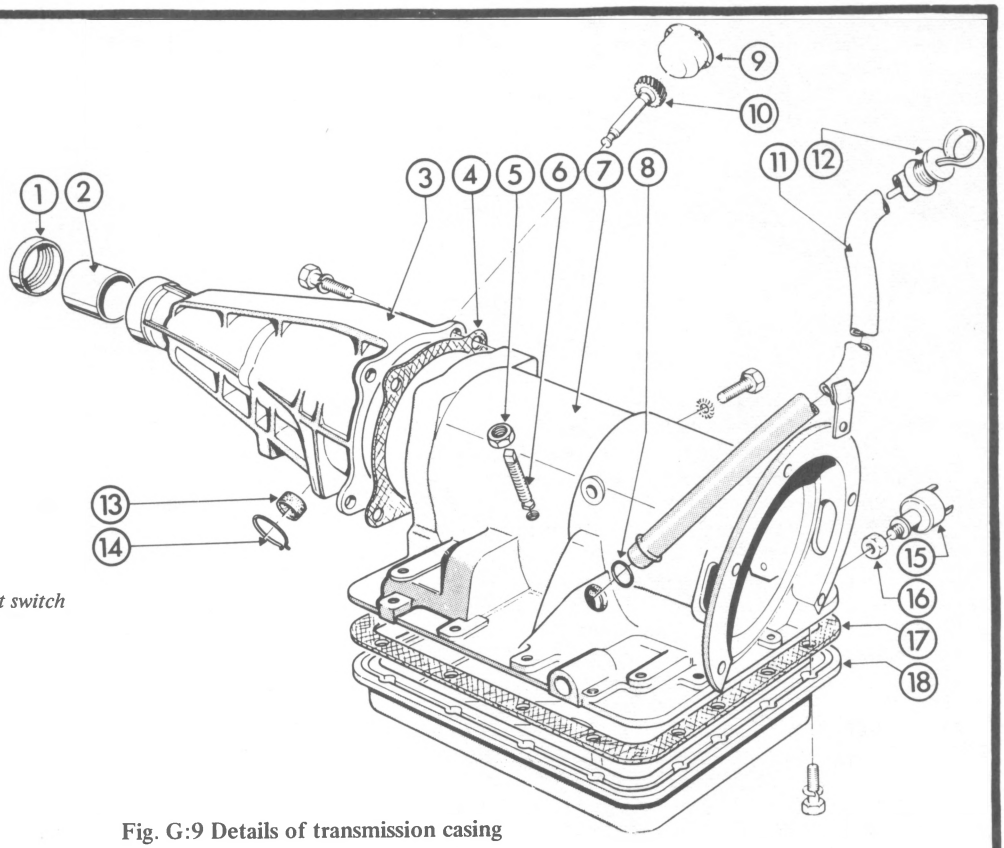


Fig. G:9 Details of transmission casing

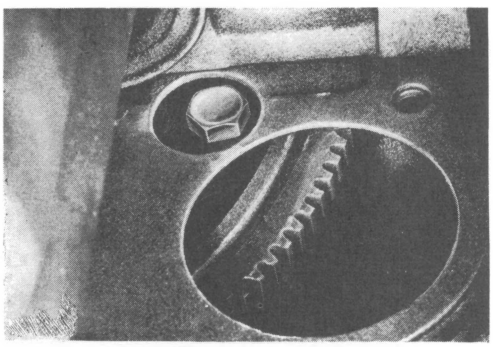


Fig. G:10 Converter to drive plate bolt access

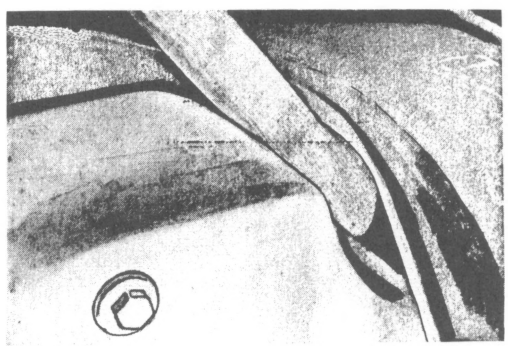


Fig. G:11 Wood block inserted between sump and crossmember

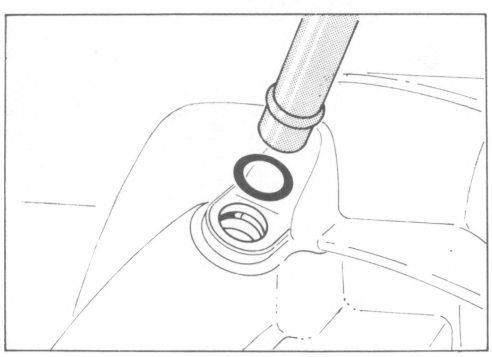


Fig. G:12 Dipstick tube sealing ring

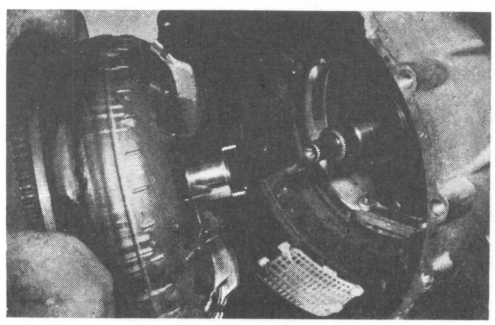


Fig. G:13 Removing torque converter

Installation

Installation is a reversal of the removal procedure, with attention to the following points:

1. Before mating the converter housing to the engine, check that the engine rear cover plate is in position.
2. When lifting the transmission unit into position, take care that the converter is not dislodged in the converter housing. It may be necessary to hold it in its location.
3. Once engaged on the engine flange shoulder, secure the converter housing by fitting two bolts on opposite sides of the housing, then refit the dipstick and filler tube assembly.

NOTE: The dipstick tube is held in position by one of the upper converter housing fixing bolts.

4. When reconnecting the starter motor leads, ensure they are not too close to the exhaust.
5. Ensure that the marks on the propshaft and rear axle flange are correctly aligned, before fitting the flange bolts.
6. Tighten all nuts and bolts to their specified torques.
7. Check the adjustment of the selector cable, as described previously under "ADJUSTMENTS".
8. Refill or top-up the transmission unit with the recommended grade of fluid and check the level, as described previously.
9. Check the adjustment of the down-shift cable, as described in "ADJUSTMENTS".
10. Check the operation of the starter inhibitor and reverse light switch and adjust if necessary.

TORQUE CONVERTER

After removal of transmission unit from the car, the torque converter can be withdrawn from the transmission input shaft, and removed from the converter housing (Fig. G:15). The torque converter will still be filled with fluid, and therefore precautions should be taken to avoid spillage.

When installing the torque converter in its housing, ensure that the drive tags on the rear of the converter and the slots in the front pump are correctly aligned. Rotate the converter so that the drive tags will be in the 9 o'clock and 3 o'clock positions. The slots in the pump driving gear are then rotated to a similar position, with the aid of a screwdriver or similar tool. Take care to ensure that the sealing ring is not damaged when sliding the converter assembly onto the transmission input shaft.

Technical Data

Make	Borg Warner
Type	BW 35
Selector positions	P–R–N–D–2–1
Converter ratio	1.91 : 1
Gear ratios	
1st	2.395 : 1
2nd	1.450 : 1
3rd	1.000 : 1
Reverse	2.094 : 1
FLUID-Type	Automatic Transmission Fluid (Ford Spec. M2C-33F)
Capacity (Transmission Dry)	6.4 Litres (11 - 25 Imp. Pts.)

Rear Axle

GENERAL
PROPSHAFT
AXLE SHAFTS
PINION SHAFT OIL SEAL
AXLE ASSEMBLY
TECHNICAL DATA

GENERAL

The rear axle is of the semi-floating type, with a hypoid crown wheel and drive pinion. The differential assembly and drive pinion are mounted in the one-piece axle housing. The axle shafts are splined to the differential side gears, and run in ball races at their outer end. The ball races are a press fit on the axle shafts.

Two different rear axle versions are used, but both are of similar construction. In physical appearance, the axles differ only in respect of the axle housing and the drive pinion flange (Fig. H:3). The type 'A' rear axle is used on all 1300 and 1600 cc models. 2000 cc cars are fitted with the type 'B' axle.

NOTE: On the type 'A' rear axle, the holes for the rear cover retaining bolts break into the axle interior, and the threads of these bolts must therefore be coated with sealing compound prior to installation.

Because of the specialised tools and knowledge required to correctly assemble the final drive unit, it is recommended that any work concerning this assembly be entrusted to an Authorised Dealer or Transmission Specialist.

For all operations, other than removal of the axle shafts and replacement of the pinion shaft oil seal, the axle assembly should be removed from the vehicle.

The propshaft may be either a one-piece shaft or a split-type; the former being used on 1300 cc models and 1600 cc manual transmission models for the domestic market, whilst the split-type is fitted to all other models.

PROPSHAFT - Removal

1. Mark the relationship of the propshaft rear flange and the rear axle pinion flange, to ensure correct alignment on reassembly. Remove the four flange bolts, and disconnect the propshaft from the rear axle.
2. On the split-type propshaft, remove the two bolts securing the centre bearing to the underbody.
3. Withdraw the front slip yoke from the transmission extension housing, and remove the propshaft. Fit a dummy shaft or other suitable plug in the rear end of the transmission, to prevent loss of oil.

Installation

1. Remove the plug or dummy shaft from the extension housing.
2. Slide the propshaft front yoke into the extension housing, and engage it with the splines on the transmission mainshaft. Take care to avoid damaging or displacing the extension housing oil seal or bearing bush during this operation.
3. On the split-type propshaft, secure the centre bearing to the underbody with the two retaining bolts, and tighten the bolts to their specified torques.
4. Align the marks on the propshaft and pinion flange, and fit the flange bolts with new spring washers. Tighten the bolts to their specified torque.
5. Finally, check the lubricant level in the transmission, and top-up if necessary.

Univeral Joints

Since the casing of the universal joints is peened together with the propshaft spiders, they cannot be renewed separately.

Centre Bearing (Split Type Propshaft)

Overhaul

1. Mark the yokes on the centre and front universal joints, to ensure correct alignment of the two sections of the shaft on reassembly (Fig. H:9).
2. Bend back the lock washer tab, slacken the bolt at the centre joint yoke, and withdraw the "U" shaped retainer plate to the side (Fig. H:6).
3. Separate the two sections of the shaft.
4. Slide the centre bearing carrier and insulator rubber off the front section, bend the six tabs on the carrier, and separate the insulator rubber from carrier.
5. Using a suitable two-legged puller, remove the bearing and protective dust caps from the front section of the propshaft (Fig. H:8).
6. To assemble press the ball race, together with the protective caps onto the front section of the shaft, using a tube of suitable diameter.
7. Bend the six metal tabs on the carrier slightly outwards, and insert the insulator rubber, boss uppermost (A, Fig. H:7), into the carrier.
8. Secure the insulator in position by bending the six tabs rearwards over the beaded edge of the insulator (Fig. H:10).
9. Slide the carrier assembly over the ball race on the end of the shaft. The semi-circular notch on the carrier must face towards the front of the shaft.
10. Screw the centre bolt with a new lock washer into the end of the shaft. Leave sufficent clearance for the retainer plate to be inserted.
11. Align the marks on the two universal joint yokes, and assemble the two sections of the shaft.
12. Fit the U-shaped retainer plate, with the tagged end towards the splines, and tighten the centre bolt to its specified torque. Secure with the lock washer.

AXLE SHAFTS - Removal

1. Jack up the rear of the car, and support on stands.
2. Remove the road wheel. With the handbrake fully released, remove the cheese-head retaining screw, and withdraw the brake drum.
3. Remove the four bolts securing the axle shaft retainer plate to the axle casing. These are accessible, two at a time, through the holes provided in the axle shaft flange.
4. Withdraw the axle shaft, using a slide hammer and adaptor bolted to the wheel studs. Alternatively, the shaft can be forced out of the casing by screwing two bolts in through the

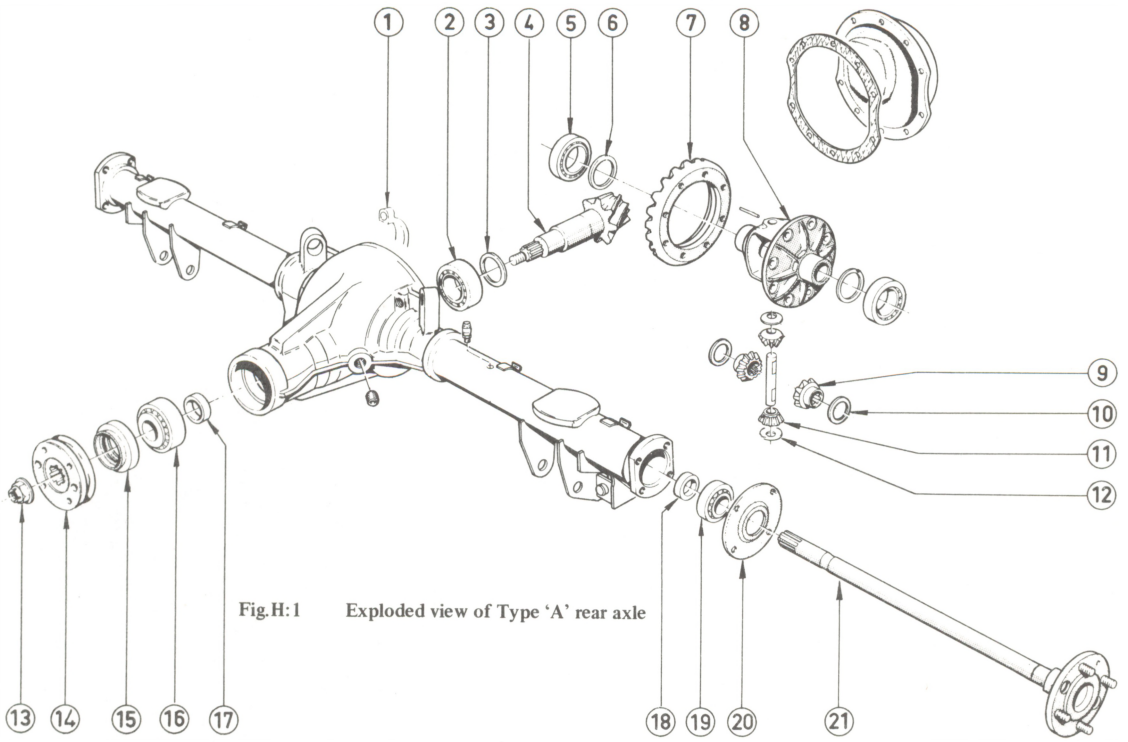


Fig.H:1 Exploded view of Type 'A' rear axle

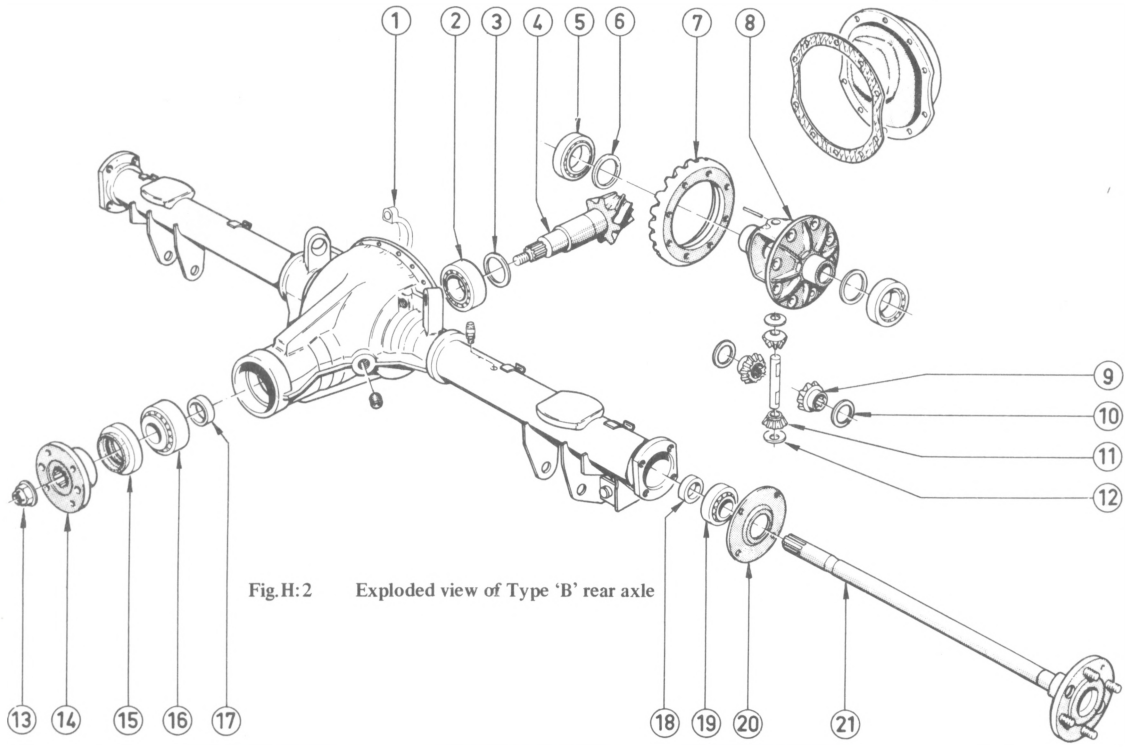


Fig.H:2 Exploded view of Type 'B' rear axle

1. Bearing cap
2. Taper roller bearing
3. Spacer shim
4. Drive pinion
5. Taper roller bearing
6. Spacer shim
7. Crown wheel
8. Differential case
9. Differential side gear
10. Spacer shim
11. Differential pinion
12. Thrust washer
13. Self-locking nut
14. Drive pinion flange
15. Pinion oil seal
16. Taper roller bearing
17. Spacer shim
18. Retaining collar
19. Ball race
20. Retainer plate
21. Axle shaft

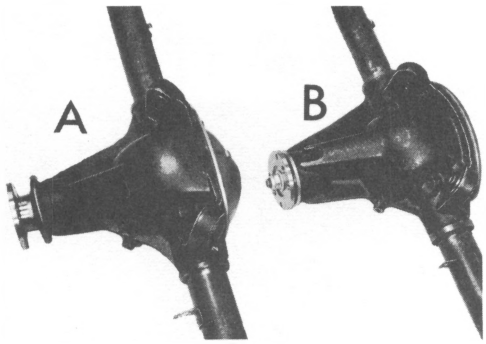


Fig. H:3 Comparison of axle versions

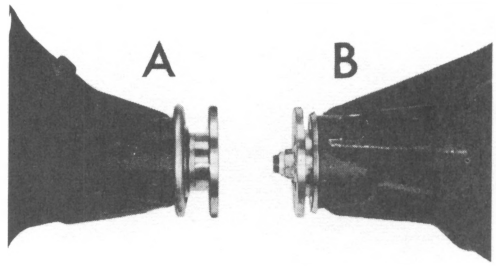


Fig. H:4 Comparison of pinion drive flanges

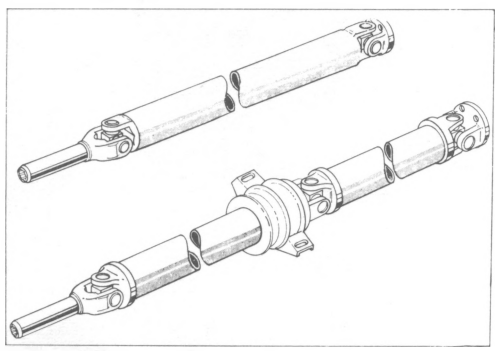


Fig. H:5 One-piece (top) and split-type propshafts

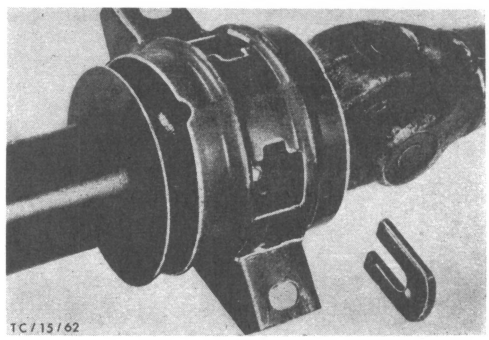


Fig. H:6 'U' shaped retainer plate

1. *Rubber bush*
2. *Carrier*
3. *Lockwasher*
4. *Centre bolt*
5. *Dust cap*
6. *Ball bearing*
7. *Dust cap*
8. *Yoke*
9. *Retainer plate*

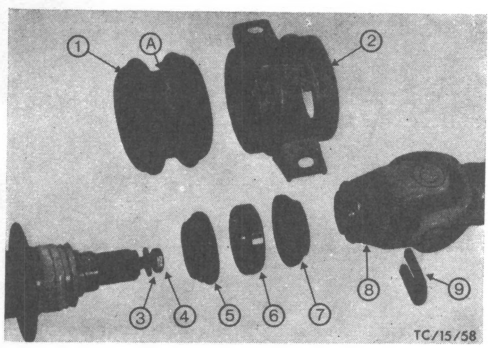


Fig. H:7 Details of centre bearing assembly

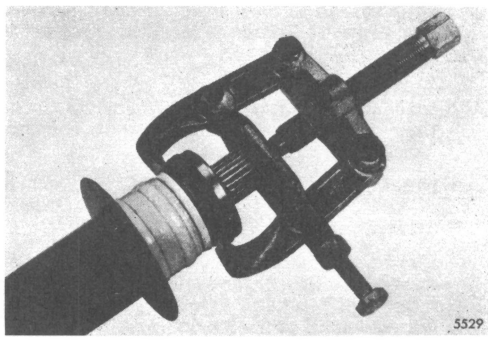


Fig. H:8 Removing centre bearing ball race

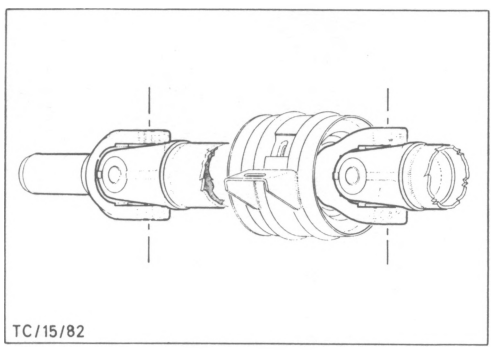


Fig. H:9 Correct alignment of joint yokes

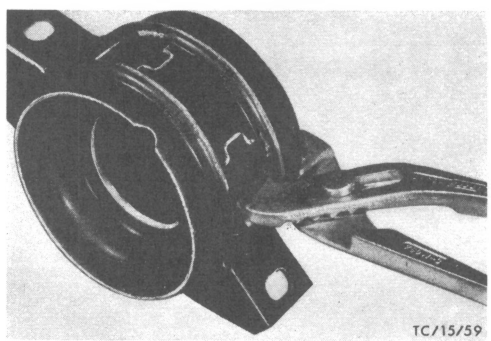


Fig. H:10 Bending tabs to secure insulator rubber

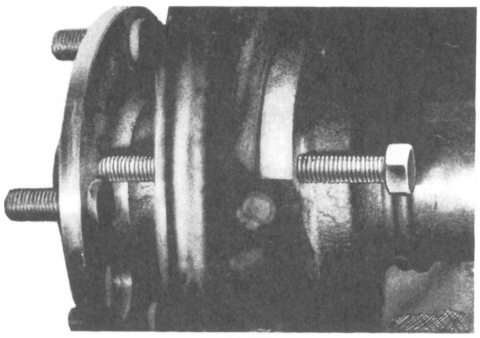


Fig. H:11 Forcing axle shaft out of axle casing

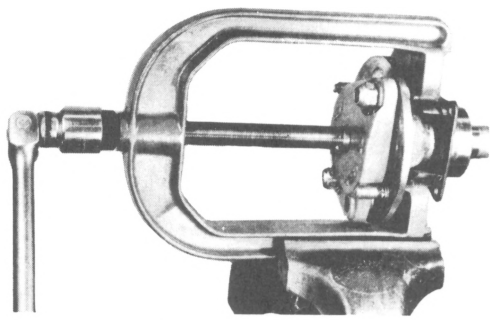


Fig. H:12 Removing axle shaft ball race

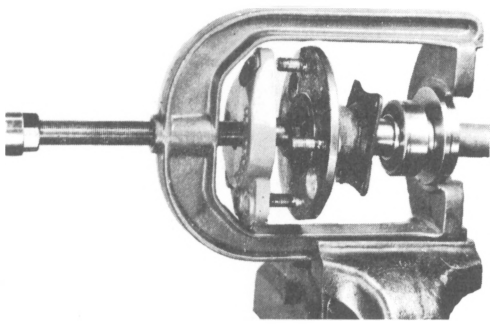


Fig. H:13 Pressing ball race and collar onto axle shaft

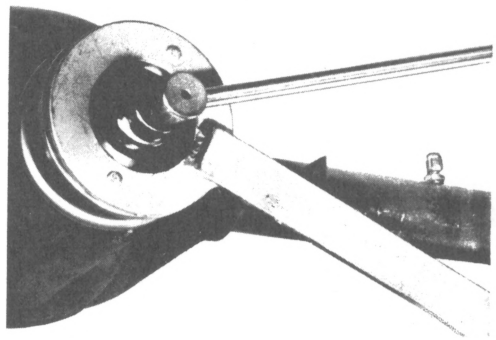


Fig. H:14 Unscrewing pinion shaft nut

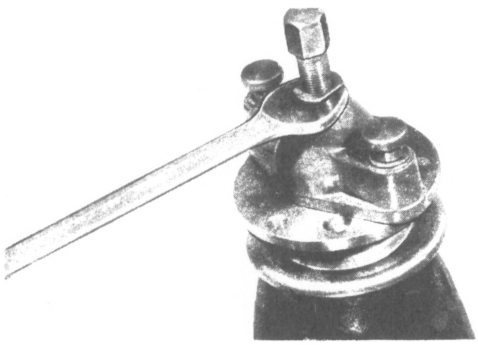


Fig. H:15 Removing drive pinion flanges

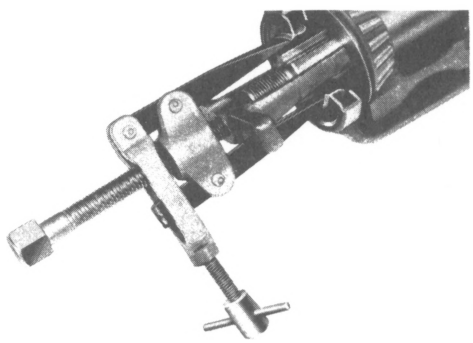


Fig. H:16 Extracting pinion shaft oil seal

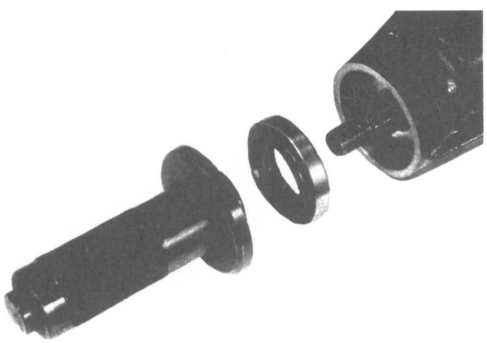


Fig. H:17 Installing new pinion shaft oil seal

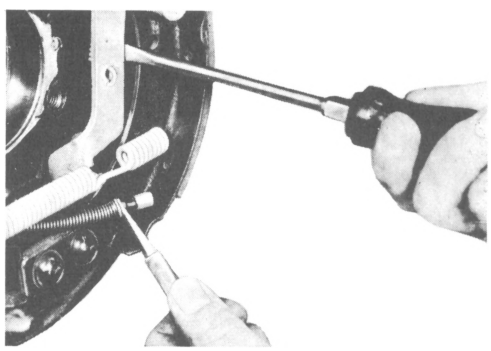


Fig. H:18 Disconnecting handbrake cable

axle tube flange, one opposite the other, from the inboard side (Fig. H:11).

5. Once the axle shaft is removed, temporarily refit one of the flange bolts to hold the brake backplate in place.

Installation

1. Coat the axle shaft and outer ball race with Lithium base grease. Insert the axle shaft into the axle tube, line up the retainer plate holes, then push the shaft into the housing as far as possible.
2. Fit the retainer plate bolts, and tighten evenly to their specified torque. Fit the brake drum, and secure with the screw.
3. Mount the road wheel, lower the car, and tighten the wheel nuts.

Bearing - Replacement

1. Drill an 8 mm (0.31 in) dia. hole in the outside diameter of the bearing retaining collar to a depth of approximately three-quarters of the thickness of the collar.
2. Split the collar across the drilled hole with a chisel.
3. Fit a suitable slave ring behind the bearing and retainer plate, and press the ball race and plate off the shaft (Fig. H:12).
4. Install the bearing retainer plate on the axle shaft. Slide the new bearing onto the shaft, with the inner oil seal away from the axle shaft flange.
5. Fit a new retaining collar on the shaft. Press the bearing and collar onto the shaft, using an installation tube or suitable slave ring (Fig. H:13). Ensure that both are squarely on the shaft, and properly seated.

NOTE: Considerable pressure is required to push and refit the bearing. The job will have to be carried out using a special press and consequently the task of fitting a new bearing to the shaft should be left to an Authorised Dealer.

PINION SHAFT OIL SEAL - Replacement

1. Jack up the rear of the car, and support on stands.
2. Disconnect the propshaft from the rear axle pinion flange, after marking the alignment of the flanges.
3. On the split-type propshaft, unbolt the centre bearing from the underbody. Lower the propshaft.
4. Clean the pinion flange and the surrounding area of the axle housing. Lock the pinion flange in position with the Flange Holding Wrench, and unscrew the self-locking nut from the pinion shaft (Fig. H:14).
5. Mark the relative positions of the flange and shaft, to ensure correct alignment on reassembly.
6. Place a drain pan under the pinion shaft, and draw the flange off the shaft (Fig. H:15). Extract the pinion seal from the housing (Fig. H:16).
7. Wipe the flange and pinion shaft clean. On the type 'A' rear axle grease the inner diameter of the new seal between the two sealing lips. On both types of axle, apply jointing compound to the outer edge of the new seal.
8. Install the seal in the axle housing, using Seal Replacer Tool No. P. 4129-B or similar to drive it home (Fig. H:17).
9. Lubricate the sealing surface of the pinion flange and the splines of the pinion shaft.
10. Slide the pinion flange onto the shaft with the marks aligned, and fit a NEW self-locking nut. Tighten the nut to its specified torque while holding the flange with the flange holding wrench.
11. On the split type propshaft, refit the centre bearing to the underbody.
12. Reconnect the propshaft to the axle pinion flange, use new spring washers on the flange bolts, and tighten the bolts to the their specified torque.
13. With the car level, check the oil level in the rear axle and, if necessary, top-up with the recommended grade of oil.

AXLE ASSEMBLY - Removal

1. Jack up the rear of the car, and support on stands placed underneath the suspension lower links (see Fig. I:4).
2. Remove the road wheels.
3. If the axle is to be overhauled or exchanged, drain out the oil. Place a drain pan under the axle housing. Clean the axle housing rear cover and surrounding area.
4. Slacken the cover retaining bolts and separate the bottom edge of the cover from the housing, to allow the oil to drain out. Retighten the bolts when the oil has finished draining.
5. Disconnect the propshaft from the axle pinion flange. If the same axle is to be refitted, mark the alignment of the flanges before disconnecting.
6. On the split-type propshaft, unbolt the centre bearing from the underbody. Lower the propshaft.
7. With the handbrake fully released, remove the cheese-head retaining screws, and pull off the brake drums.
8. Disconnect the handbrake cables from the brake assemblies (Fig. H:18).
9. Disconnect the brake hose from the brake pipe and mounting bracket on the axle casing. Plug the ends of the pipe and hose, to prevent loss of fluid and the ingress of dirt.
10. Detach the suspension upper links fromt their mountings on the axle casing (see REAR SUSPENSION Fig. I:12).
11. Detach the shock absorbers from their lower mountings.
12. Remove the nuts and through bolts from the suspension lower link mountings on the axle, and lift out the axle assembly.

NOTE: Once removed from the car, do not allow the axle assembly to stand on the brake backplates, as this may distort them.

13. If required, the axle shafts can be removed, as described previously. See BRAKES section for details of the brake assembly removal.

Installation

Install the axle assembly in the reverse order of removal. Tighten all nuts and bolts to their specified torques. Do not fully tighten the suspension link through-bolts until the weight of the car is on its wheels. Bleed the brakes, as described in the BRAKES section. When installation is completed, fill the axle with the recommended grade of oil.

Technical Data

Rear Axle Ratio	std	opt
1300 cc	4.11	4.44
1600 cc - saloon	3.89	4.11
- estate	4.11	–
2000 cc - saloon	3.70	3.89
- estate	3.44	3.70

Speedometer Drive	Driven Gear	Drive gear
Axle ratio		
4.44	6	24
4.11	7	25
3.89	7	24
3.7	7	23
3.44	7	22

Axle Lubricant

Type	SAE 90 Hypoid Gear Oil (to Ford Spec. M2C-28BA)
Capacity	1.1 litre (2.0 Imp. Pts.)

Propshaft

Type 1300 cc	One-piece
1600 cc Man. Trans.	
(Domestic)	One-piece
(Export	Split-type
1600 cc Auto. Trans.	Split-type
2000 cc	Split-type
No. of splines	
One-piece	20
Split-type	25
Lubricant	Special-purpose Lithium-base grease (SM-1C-4515A).

Rear Suspension

GENERAL
SHOCK ABSORBERS
STABILISER BAR
LOWER LINK AND SPRING
UPPER LINK
PINION NOSE ANGLE
TECHNICAL DATA

GENERAL

The rear suspension is of the coil spring and link type (Fig.-I:1).Two trailing lower links and two diagonal upper links combine to absorb cornering forces and control axle movement. The coil springs are mounted between the lower links and underbody and on earlier models are attached to the lower links by a retaining plate and bolt. Later models from autumn 1973 incorporate a raised centre spigot (boss) on the lower arm and the need for a retaining plate is obviated. On both early and late models the coil springs are held to the upper body by the compression action of the car weight, and the travel limit of the shock absorbers and control arms. Also from Autumn 1973 the rear suspension incorporates an anti-roll bar (stabiliser bar) which is attached to the two lower link arms (Fig. I:1).

The direct acting hydraulic shock absorbers are mounted at an angle between the axle body and car underframe to provide control stability.

From January 1972 the Cortina is fitted with a modified lower link arm and axle case mounting, which enables adjustment to the drive angle. Identification is by serrated washers (which are used in conjunction with nuts and bolts) on the link arm attachment to the rear axle casing. When ever the axle or lower link arm has been removed the pinion nose angle should be checked and adjusted as required. This will ensure correct alignment of the drive line.

SHOCK ABSORBERS

Check the effectiveness of the shock absorbers by bouncing the rear of the car up and down. If they are in good order the car will settle to its normal position immediately. Continous movement after the car is released will indicate shock absorber deficiency. In this case the shock absorber should be removed and tested as described below.

Removal

1. To remove the shock absorber detach it from its mounting on the upper body and axle case (Fig. I:2).

Testing

1. With shock absorber held vertically, extend and compress it to its full extent several times.
2. Clamp the lower end in the jaws of a vice, again with the unit positioned vertically.
3. Extend the piston rod to its full length, and then compress it. There should be a constant resistance during the complete cycle.
4. Any variation or sudden loss of resistance indicates the presence of air in the system, loss of fluid, or a faulty valve. If the action is not correct, the shock absorber should be replaced.

Bushes

1. If the rubber mounting bushes are worn, damaged, or perished, or if the spacer sleeves are worn, the bushes should be replaced.
2. Drive out the spacer sleeve, then remove the rubber bush. Fit the new bush first, then drive in the spacer sleeve (Fig. I:2).

Replacement

1. Locate the shock absorber on the axle mounting pin and fit the flat washer and nut.
2. Position the upper end in the body mounting bracket, insert the through-bolt, and fit the retaining nut (Fig. I:2). Tighten both mountings to their specified torque.

STABILISER BAR - Overhaul

1. Remove the four bolts securing the stabiliser bar to the lower link arms and remove the stabiliser bar (Fig. I:4).

Bushes

1. Check the bushes for wear, cracking, and perishing.
2. Replace as necessary.
3. To renew bushes remove the self locking nuts and withdraw front and rear brackets with the insulator bushes.
4. Press the spacer and bush out of the bracket (Fig. I:3).
5. Apply lubricant to a new bush and insert spacer and bush into bracket.
6. Replace brackets in the reverse order of removal. Refit stabiliser bar.

LOWER LINK AND SPRING - Remove/Replace

1. Slacken the wheel nuts and jack up the rear of the car.
2. Place axle stands under the body. Remove the road wheel.
3. Whichever side is to be dismantled disconnect the stabiliser bar (not applicable to early models). Swing it to one side.
4. Jack up the rear of the car slightly and remove the shock absorber lower mounting.
5. Lower the jack, press down on the axle and pull the spring out of its upper mounting.
6. Slightly twist the spring to remove it from the centre boss on the lower radius arm. On early models pre-Autumn 1973 remove the clamping bolt and clamp (Fig. I:5).
7. Remove the spring.
8. Disconnect the lower link arm from its mountings and withdraw it.
9. To replace the lower link fit the link arm to the body and axle mountings - do not tighten at this stage.

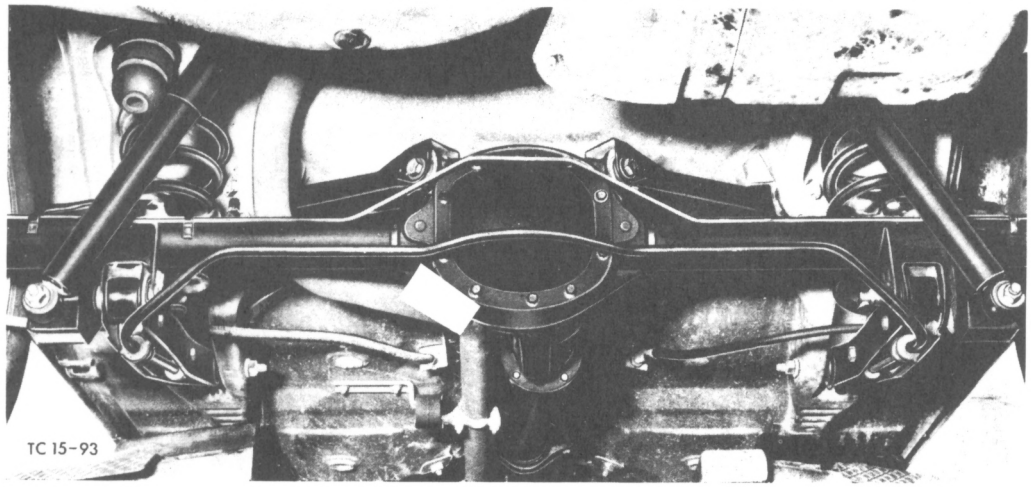
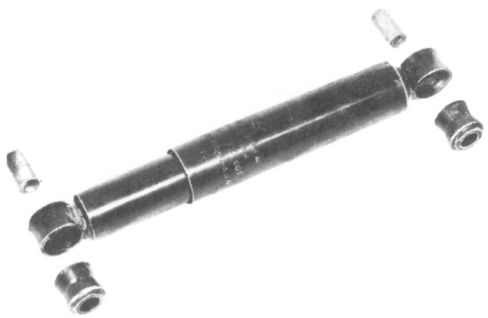


Fig. I:1 Rear suspension assembly - 1973 on



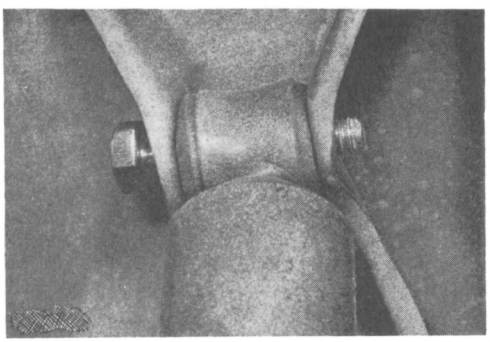


Fig. I:2 Shock absorber

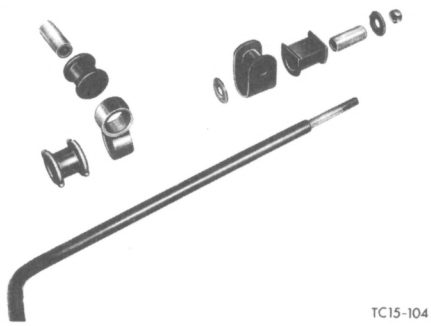


Fig. I:3 Stabiliser bar bushes

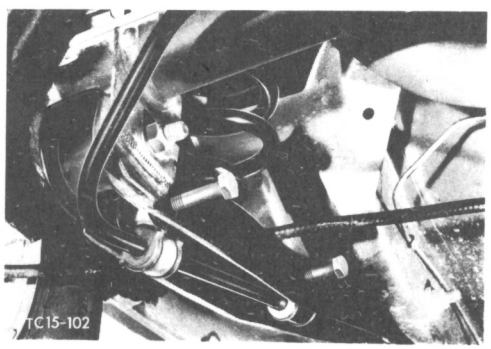
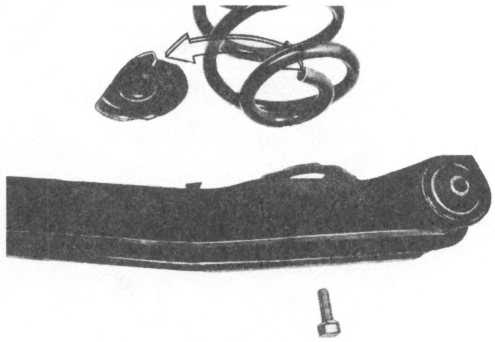
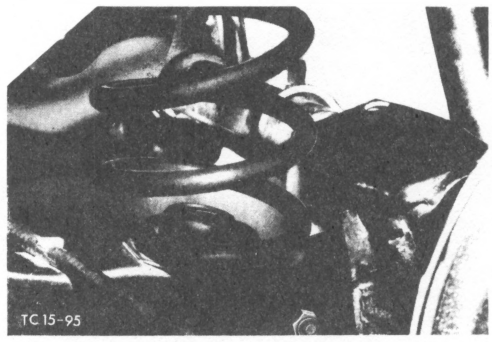


Fig. I:4 Stabiliser bar removal



Pre 1972



1972 on

Fig. I:5 Coil spring mounting (lower link)

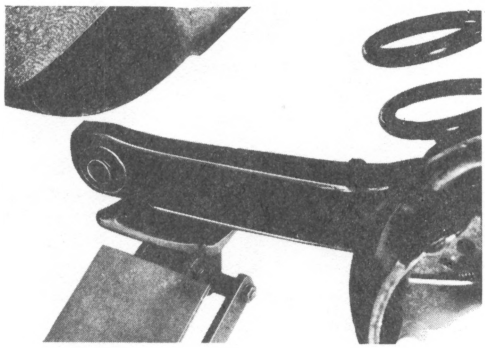


Fig. I:6 Supporting lower link

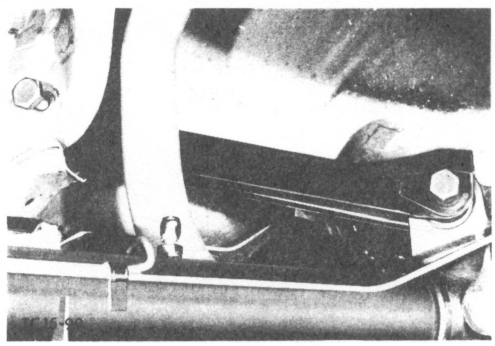


Fig. I:7 Upper link mountings

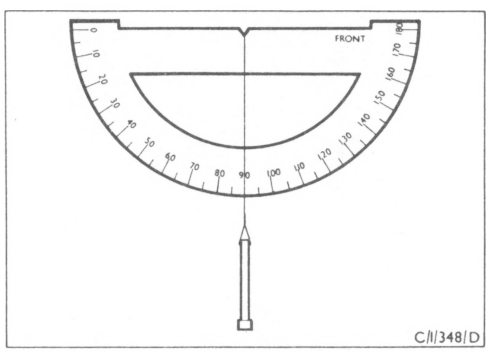


Fig. I:8 Protractor

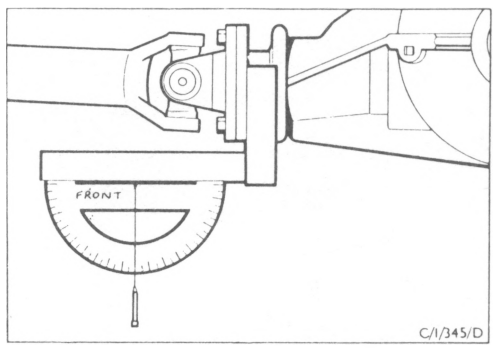


Fig. I:9 Measuring pinion flange angle

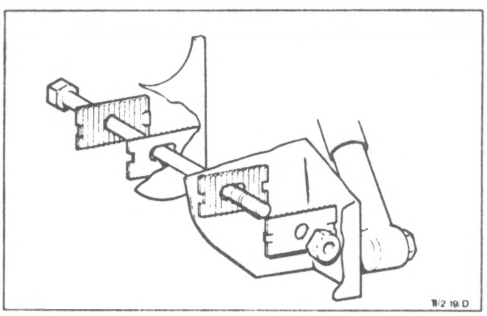


Fig. I:10 Pinion angle adjustment point

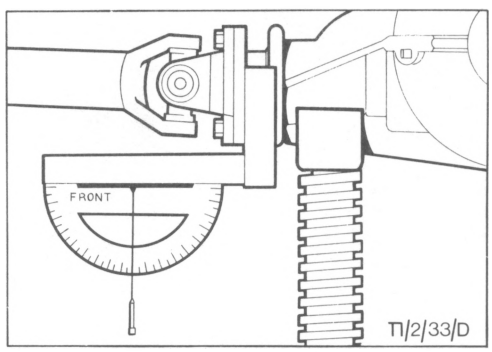


Fig. I:11 Adjusting pinion angle with a jack

10. Place the rubber ring onto the spring and place spring into its upper mounting. Press down on rear axle case and insert spring into the lower mounting.

11. Jack up the rear axle and attach the shock absorber and stabiliser bar (where fitted).

12. Refit road wheel, lower car to the ground and torque tighten the lower link retainer bolts.

NOTE: After replacement of the lower link arm check the pinion drive line angle. See later in this section.

13. To replace coil spring only place a jack under the front end of the lower link.

14. With jack in position remove the front link mounting bolt and gently lower the jack (Fig. I:6).

15. The spring lower seat can now be unbolted from the link (early models) or twisted and removed from the boss on later models (Fig. I:5).

16. There are slight differences in coil spring design on different models. These are identified by paint marks. When renewing a coil spring always ensure that correct replacement is obtained. Failure to adhere to this instruction will affect the handling of the car.

UPPER LINK - Remove/Replace

1. Follow steps 1. through to 7. as for LOWER LINK AND SPRING with the following additional steps.

2. Jack up the rear axle sufficiently to remove shock absorber completely.

3. With spring removed jack up the axle again and remove the top link retaining bolts at both ends. Disconnect link arm from chassis and axle housing (Fig. I:7) and remove upper link arm.

4. Replace the upper link arm in the reverse order of removal. Torque up the link arm bolts when the car is on the ground.

PINION NOSE ANGLE - Adjust (applicable to vehicles from January 1972)

1. First of all measure the angles using a suitable protractor (Fig. I:8).

2. To accomplish angle measurement drive the vehicle unladen over a pit.

3. Attach the protractor to the longitudinal member of the chassis and jack up the front or rear axle so that the car body is dead level

4. With the car level measure the angle of the propshaft flange (Fig. I:9) The angle should be as follows:

a. Single piece propellor shaft 2^{o} to $3^{o}30'$ inclined forwards.

b. Split propeller shaft 0^{o} to $1^{o}30'$ inclined forwards.

5. If the stated angles are not evident adjust the pinion nose angle as follows:

6. Slacken the lower link arm nuts and bolts at the axle end so that the serrated washers are separate from each other (Fig. I:10)

7. Position a jack under the differential unit bulge so that the protractor can be placed behind the rear flange (Fig. I:11).

8. Jack up the differential carrier so that the correct angle is obtained.

9 Push the loose serrated washers on the bolts onto the axle bracket washers so that they engage. Make certain they are not offset in relation to each other and finger tighten nuts

10. With above operations completed check that the lower link attachment bolts are at right angles to the vehicle centre line.

11. Lower car to the ground and torque tighten the retaining bolts and nuts.

12. With drive angle adjusted and car on the ground check the propshaft to car floor clearance. This should be as follows:

a. Single piece propshaft (rear end) 106 mm (4.17 in)

b. Split piece propshaft (from drive flange) 130 mm (5.12 in).

Technical Data

Type: Link arms, coil springs and telescopic shock absorbers. Anti-roll bar fitted as from Autumn 1973.

Car Models		1.3 LC/HC		1.6 LC/HC		1.6 GT; 2.0 HC	
		Standard	**HD**	**Standard**	**HD**	**Standard**	**HD**
Spring Wire Diameter	mm	13.1	13.4	13.1	13.4	13.4	13.4
	(in)	(0.516)	(0.528)	(0.516)	(0.528)	(0.528)	(0.528)
Coil Inside Diameter	mm	102.8	102.8	102.8	102.8	102.2	102.2
	(in)	(4.047)	(4.047)	(4.047)	(4.047)	(4.024)	(4.024)
Number of Turns	mm	6.3	6.0	6.3	6.0	6.0	6.0. .
	(in)	(0.25)	(0.236)	(0.25)	(0.236)	(0.236)	(0.236)
Free Spring Height	mm	279	277	279	277	273	277
	(in)	(11.0)	(10.9)	(11.0)	(10.9)	(10.75)	(10.9)
Installed Height	mm	215.7	215.2	215.7	215	217	215.2
	(in)	(8.49)	(8.47)	(8.49)	(8.47)	(8.54)	(8.47)
Spring Rate	mm/100 kg	26.6	23.2	26.6	23.2	23.2	23.2

For Torque figures see TIGHTENING TORQUES

Front Suspension

GENERAL
SUSPENSION ALIGNMENT
FRONT HUB ASSEMBLY
SHOCK ABSORBERS
COIL SPRINGS
LOWER SUSPENSION ARMS
UPPER SUSPENSION ARMS
BUMP RUBBERS
STUB AXLES
TIE BARS
STABILISER BAR
TECHNICAL DATA

GENERAL

The front suspension is of the independent link type, and is mounted on a separate suspension frame. The suspension assembly at each side consists of an upper and lower suspension arm, a lower arm tie bar, a stub axle assembly, coil spring and telescopic shock absorber. 1600 GT and 2000 cc models are fitted with a transverse stabiliser bar which acts on the lower arm tie bar through a short connecting link. Base L and XL models have standard suspension, whilst GT and GXL models have Rally Suspension.

The suspension arms are rubber bushed at their frame mounting points, and carry the stub axle ball joints at their outer ends. The tie bar is connected between the lower control arm and a forward mounting bracket on the suspension frame, and acts to control the fore and aft movement of the lower control arm. The tie bar affords adjustment of the castor angle, which with the exception of the front wheel toe-in, is the only adjustment required.

The coil spring acts on the lower control arm, and seats between the arm and a mounting pad on the suspension frame. The direct-acting hydraulic shock absorber is located inside the spring, and is attached to the lower suspension arm and the suspension frame above the spring mounting pad.

The front hub assembly runs on two opposed tapered roller bearings, and is retained on the stub axle by a hub nut and nut retainer. The brake disc is bolted to the inboard face of the hub assembly. The brake splash shield and brake caliper are mounted on the upright of the stub axle assembly.

SUSPENSION ALIGNMENT

The castor, camber, king pin inclination, front wheel toe-in, and toe-out on turns should be checked after any overhaul procedure in which a suspension component has been removed or its location altered. It should also be checked at regular intervals, particularly if the suspension has been subjected to heavy impact, as excessive wear or accident damage may disturb one or more of the settings.

The castor angle, with the exception of the front wheel toe-in, is the only adjustment possible on the front suspension. Castor adjustment is effected by altering the position of the nuts at the front mounting of the lower control arm tie bar (Fig. J:3).

Specialised knowledge and equipment, including front and rear suspension height alignment spacers (Tool No. 14.003,) are necessary to check and set the front suspension alignment correctly. It is therefore recommended that the checking and setting of the suspension alignment be entrusted to an Authorised Dealer.

Alignment spacers are not required to check or adjust the front wheel toe-in, but the toe-in setting should only be checked and adjusted after it has been determined that the other alignment settings are to specification. A method of setting the toe-in is given in the steering section, but this should only be used as a temporary measure after the replacement of steering or suspension components. The suspension alignment should then be rechecked as soon as possible afterwards, using proper equipment.

FRONT HUB ASSEMBLY - Adjusting

1. Raise the wheel clear of the ground.
2. Remove the hub cap, and lever the grease cap from the hub. Extract the split pin, and remove the nut retainer.
3. Release the hub nut several turns, then rock the wheel and hub assembly in and out a few times, to push the brake pad away from the disc.
4. Tighten the hub nut to 3.7 kgm (27 lb.ft.) while rotating the wheel in its normal direction of rotation to seat the bearings. Slacken the nut back until an end-float of 0.03 - 0.13 mm (0.001 - 0.005 in) is obtained when a load of 9 - 23 kg (20 - 50lb) is applied to the wheel.
5. Refit the nut retainer on the hub nut so that one set of slots are in line with the hole in the spindle, and secure with a new split pin.
6. Check that the wheel rotates freely without roughness, or drag. If not, the bearings should be cleaned and inspected, as described below. If satisfactory, tap the grease cap into place, and and refit the hub cap.

NOTE: Pump the brake pedal several times, to bring the pads into their correct operating position before driving the car.

Remove

1. Jack up the front of the car, and support body on chassis stands. Remove the road wheel.
2. Bend back the lock tabs, and unbolt the brake caliper from the mounting lugs on the stub axle assembly. Suspend the caliper from a suitable point on the suspension, to avoid straining the brake hose.

NOTE: On later models owing to rerouting of brake pipes A 19 mm (0.74 in) crowsfoot spanner should be used to torque up the bottom retaining bolt (Fig. J:5). Use this tool when removing retaining bolt. If tool not available then disconnect brake pipe at bracket. On assembly bleed the brake system.

3. Lever the grease cap from the hub, extract the split pin, and remove the nut retainer, hub nut and thrust washer from the stub axle.
4. Remove the outer bearing cone and roller assembly from the hub (Fig. J:6), then draw the hub assembly off the axle (Fig. J:7).

BEARING - Remove

1. Extract the grease seal from the rear of the hub, and lift out the inner bearing cone and roller assembly (Fig. J:8).

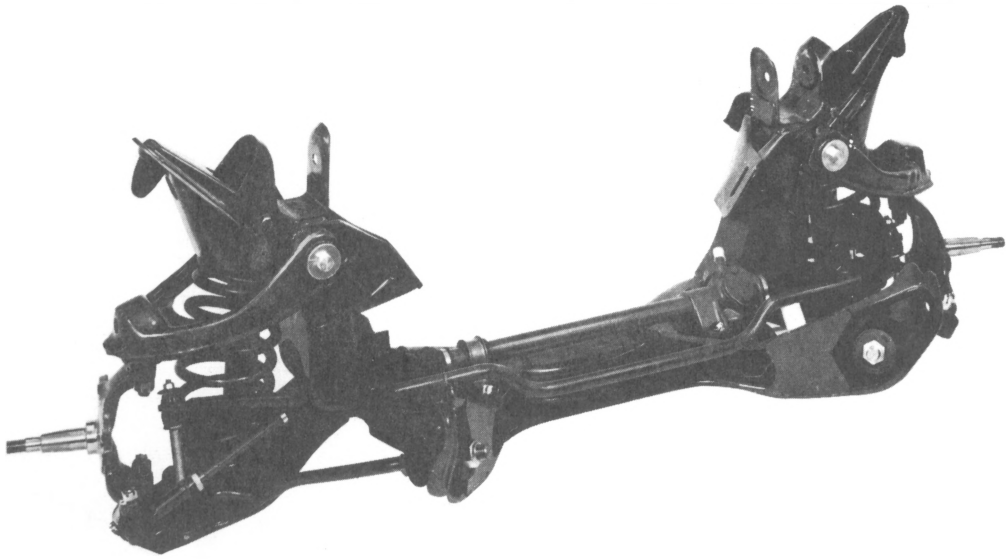


Fig. J:1 General view of front suspension assembly

1. *Bump rubber (early type)*
2. *Upper suspension arm*
3. *Upper swivel joint*
4. *Stabiliser bar*
5. *Stabiliser bar bush*
6. *Stud axle*
7. *Stabiliser bar connecting link*
8. *Suspension tie bar*
9. *Lower arm mounting bush*
10. *Suspension frame*
11. *Coil spring*
12. *Upper arm mounting bush*
13. *Shock absorber*
14. *Body mounting bracket*

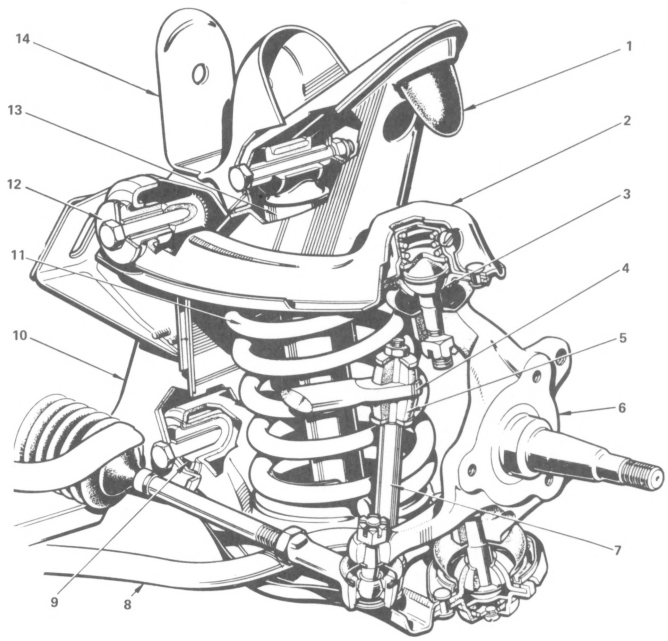


Fig. J:2 Cut-away view of L.H. suspension assembly (Early type)

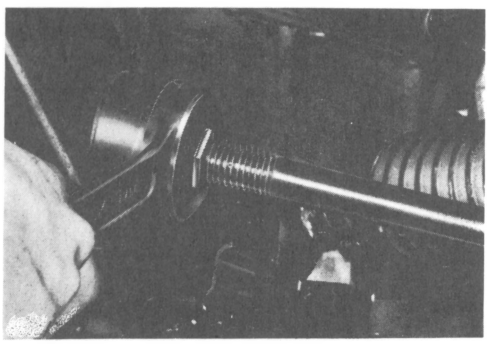


Fig. J:3 Castor adjustment

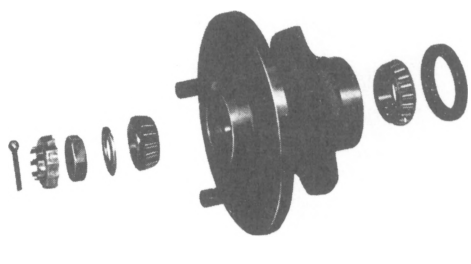


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Fig. J:4 Front hub assembly

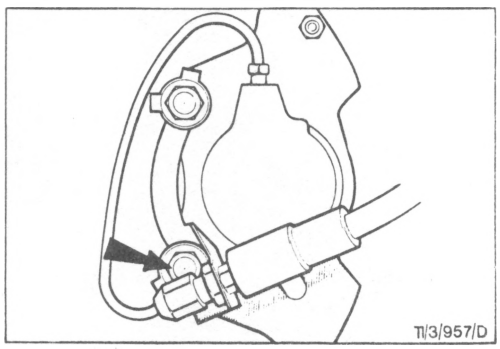


Fig. J:5 Front caliper bolt removal (Later model)

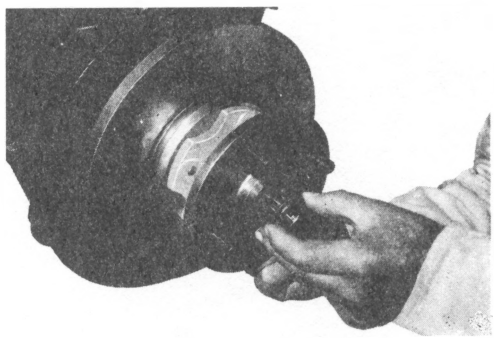


Fig. J:6 Removing outer bearing cone and roller assembly

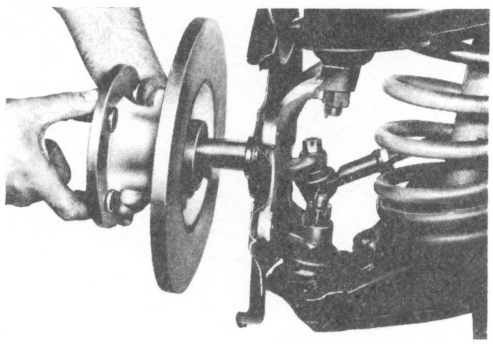


Fig. J:7 Removing hub assembly

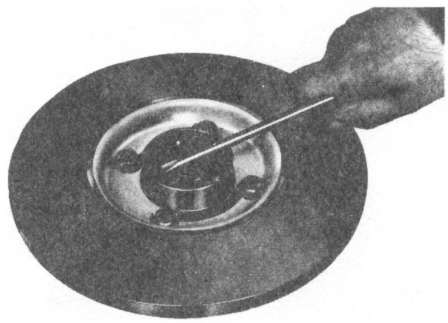


Fig. J:8 Removing hub grease seal

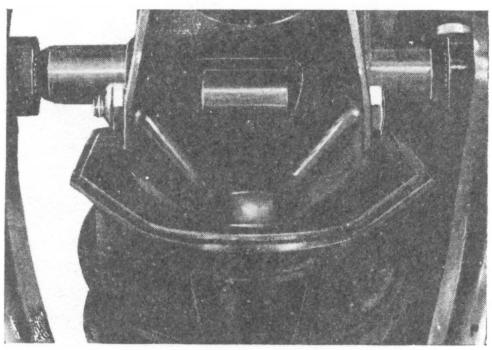


Fig. J:9 Shock absorber top mounting

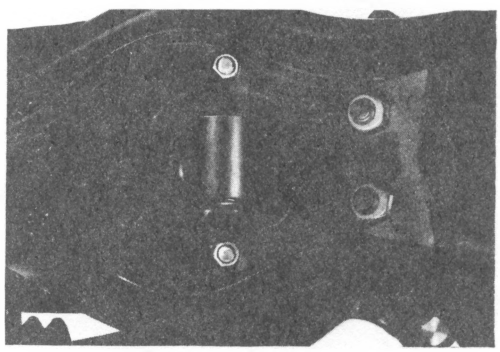


Fig. J:10 Shock absorber lower mounting

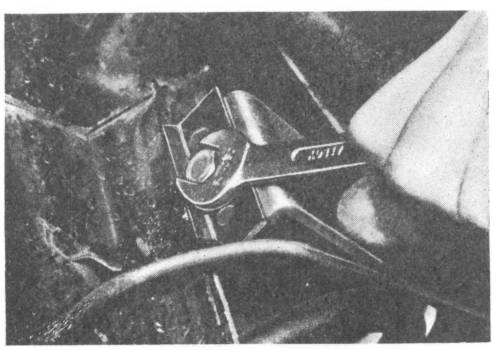


Fig. J:11 Removing brake bracket bolt

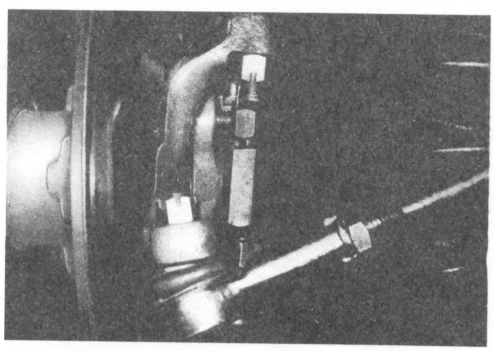


Fig. J:12 Separating swivel joint ball stud

2. Wash the bore of the hub, the bearing cone and roller assemblies thoroughly with petrol to remove all old grease, dirt, etc. Take care to avoid getting grease or solvent on the friction surfaces of the brake disc. Dry the components thoroughly with compressed air, but do NOT spin the bearings under air pressure, as this may damage the rollers. The bearings may, however, be spun by hand to dry them.

3. Examine the bearing cups inside the hub bore for scratches, pits, or excessive wear. Inspect the cone and roller assemblies for wear or damage. If damage or wear to the cups or cone and roller assemblies of either bearing is present, BOTH bearings should be replaced as a unit.

Refit

4. If satisfactory, pack the cone and roller assemblies with fresh Lithium-base grease, working as much lubricant as possible between the rollers and cages. Also lubricate the cone surface.

5. Fit the inner bearing cone and roller assembly in the rear of the hub.

6. Install a new grease seal with lip towards the bearing, after first filling the space between the seal lips with grease. Ensure that the seal is correctly seated in the hub bore.

Refit the hub assembly on the stub axle, as described below.

Replace

1. When either the cup or cone and roller assemblies required replacement, both bearings should be replaced. Always fit new bearing cups when replacing the bearing cones and ensure that the cup and cone are of the same manufacture. The manufacturers name is stamped on the cone and the initial letter of the name is stamped on the cup, (e.g. T = Timken, S = Skefco).

2. Remove both bearing cone and roller assemblies, and wash out the hub, as described above.

3. Remove the bearing cups from the hub, one at a time, with Bearing Cup Remover/Installer Tool P.1024 and Adaptor P. 1024 - 9. Take great care to avoid damaging the hub bore during this operation, as this could prevent the new cups seating properly.

NOTE: If a special tool isn't available then it is possible to knock out the bearing cups using a drift. It is essential that the hub is firmly held and that the drift has a 'clean' edge so ensuring that the hub is not damaged during cup removal. Move the drift from one side to the other so that the cup is removed evenly. The old cups can be used to aid replacement.

4. Install the new bearing cups, taper face outwards, using the same tools as for removal. Ensure that the cups are properly seated in the hub bore.

5. Wash, dry, and repack the new bearings, as described above.

Hub Assembly - Refit

1. Lubricate the lip of the hub seal with grease, and install the hub assembly on the stub axle.

NOTE: Keep the hub centred on the axle to avoid damaging the hub seal or the axle threads.

2. Install the outer bearing cone and roller assembly in the hub, fit the thrust washer, then screw hub nut onto the stub axle.

3. Fit the brake caliper over the disc, and using new lock plates, secure it to the stub axle mounting lugs with the two retaining bolts.

4. Tighten the caliper bolts to their specified torque, and secure with the lock plate tabs. Refit the road wheel. Adjust the wheel bearings, as described previously.

NOTE: On later models refit bottom bolt and brake pipe bracket. Torque up bolt with crowsfoot spanner. If spanner not available refit bolt and brake pipe bracket. Torque up bolt, refit brake pipe to bracket and bleed the braking system.

SHOCK ABSORBERS - Testing

The effectiveness of the front shock absorbers can be checked either on or off the car, in the same manner as described for the rear shock absorbers in the REAR SUSEPNSION section.

Remove

1. Jack up the front of the car, and support body on chassis stands.

2. Place a bottle jack under the lower suspension arm, and slightly compress the arm and spring.

3. Remove nut, and withdraw the shock absorber top mounting bolt (Fig. J:9).

4. Remove the two nuts securing the shock absorber lower mounting to the lower suspension arm, and withdraw the shock absorber downwards through the aperture in the lower arm (Fig. J:10).

Refit

Install the shock absorber in the reverse order of removal.

COIL SPRINGS - Remove

1. Jack up the front of the car, and support on chassis stands. Remove the road wheel.

2. Remove the brake bracket bolt, and push the brake pipe to one side, to allow sufficient access for the spring compressor to be fitted (Fig. J:11).

3. Compress the coil spring, using Spring Compressor Tool No. P.5045. Detach the shock absorber at its top and lower mounting, and withdraw the shock absorber downwards through the coil spring and lower arm aperture.

4. Extract the split pin, and remove the ball stud retaining nut from the lower swivel joint.

5. Free the joint taper from its location in the stub axle, using a suitable joint separator tool (Fig. J:12). Similarly, disconnect the steering rod end from the stub axle.

6. Lower the suspension arm sufficiently to permit the coil spring to be withdrawn (Fig. J:13).

NOTE: There are slight differences in coil spring design of the various models, and the springs are identified by coloured paint spots. When replacing a coil spring ensure that the correct replacement is obtained, otherwise handling could be adversely affected.

Refit

Installation is a reversal of the removal procedure. Secure with ball stud retaining nuts and new split pins.

LOWER SUSPENSION ARMS - Remove

1. Remove the coil spring, as described above.

2. Remove the two bolts and nuts securing the tie bar to the lower suspension arm.

3. It may be necessary to slacken the tie-bar front locknut at its suspension frame mounting bracket. Note the number of flats by which the nut is released so that it can be reset in its original position (Fig. J:14).

4. Remove the retaining nut, and withdraw the through bolt securing the lower arm to the suspension frame. Remove the arm (Fig. J:15).

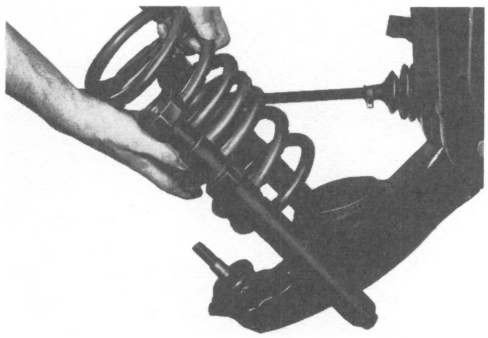


Fig. J:13 Removing compessor coil spring

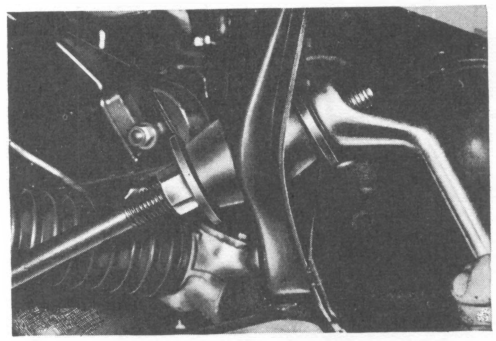


Fig. J:14 Slackening tie bar front locknut

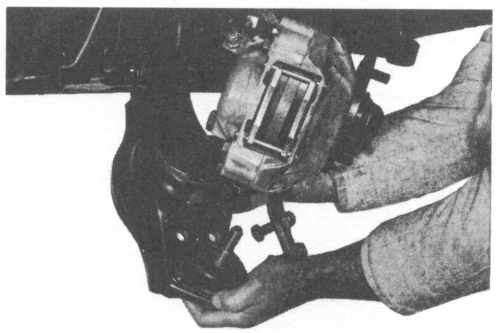


Fig. J:15 Removing lower suspension arm

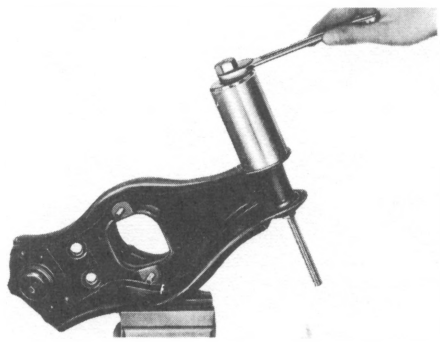


Fig. J:16 Replacing lower arm bush

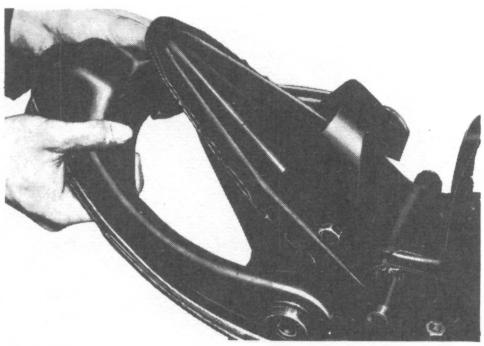


Fig. J:17 Removing upper suspension arm

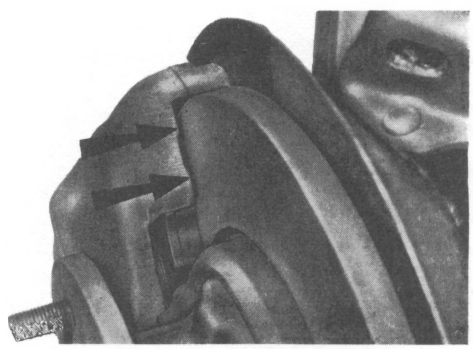
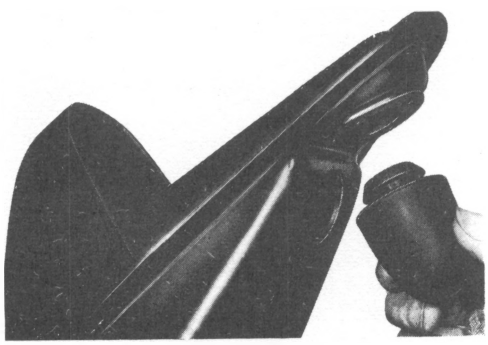
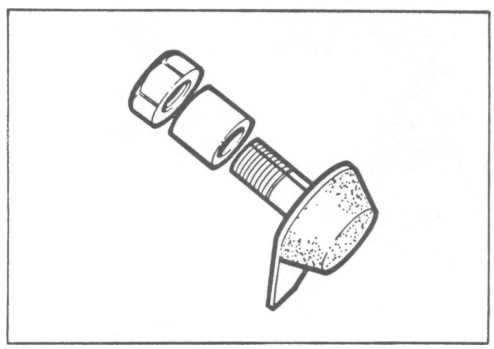


Fig. J:18 Checking for stub axle distortion



Early type



Later type

Fig. J:19 Removing bump rubber

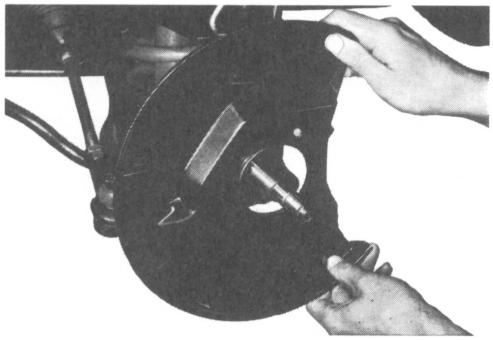


Fig. J:20 Removing brake splash shield

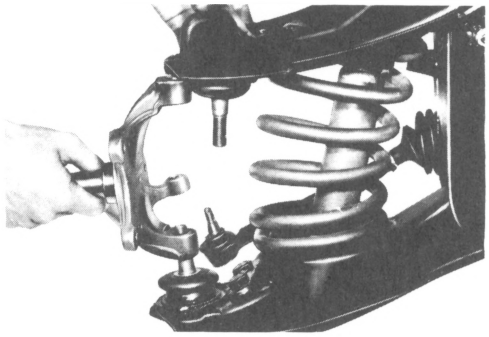


Fig. J:21 Removing stub axle

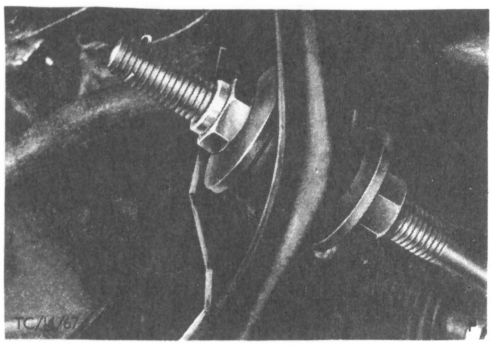


Fig. J:22 Removing tie bar

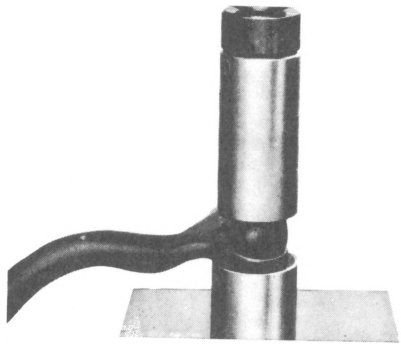


Fig. J:23 Installing tie bar bush

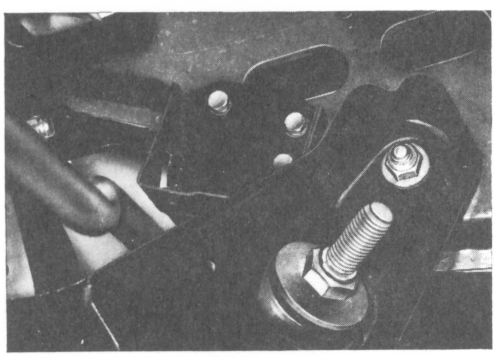


Fig. J:24 Stabiliser bar mounting bracket

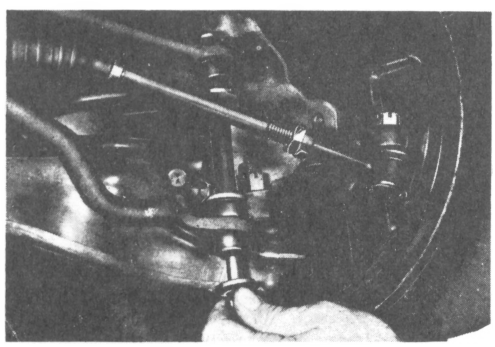


Fig. J:25 Disconnecting stabiliser bar connecting link

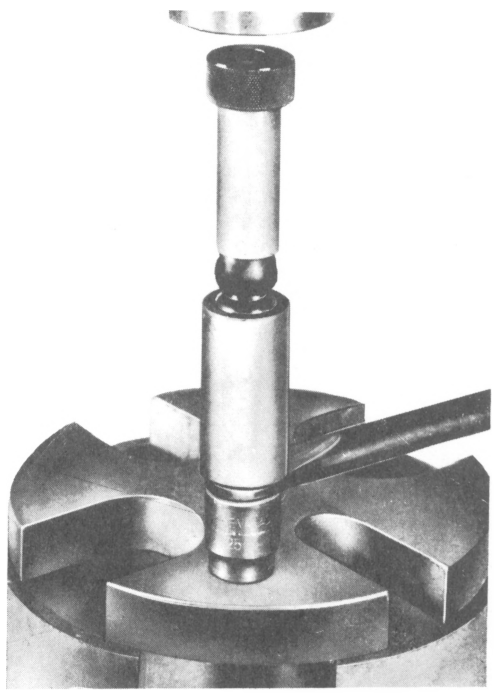


Fig. J:26 Installing stabiliser bar bush

Replace

If the rubber bush at the inner end of the arm is worn, damaged or perished, it should be replaced. Withdraw the old bush, and fit a new one using Bush Remover/Replacer Tool No. 14.004 (Fig. J:16).

Refit

Installation is a reversal of the removal procedure. Ensure that the lower arm mounting bolt is fitted with the bolt head facing the front of the car. Do not tighten the arm mounting bolt and nut until the weight of the car is on its wheel. Secure the nuts with new split pins where applicable.

NOTE: On later models the bottom bush has a thicker inner tube to suit the waisted bolt and 'nyloc' nut. Do not use washers at either end of bolt. Torque tighten with weight of car on wheels (see TIGHTENING TORQUES).

UPPER SUSPENSION ARMS - Remove/Refit

1. Jack up the front of the car, and support on chassis stands. Remove the road wheel.
2. Extract the split pin, and remove the ball stud retaining nut from the upper swivel joint.
3. Free the joint taper from its location in the stub axle, using a suitable joint separator (Fig. J:12). Remove the retaining nut, and withdraw the long through-bolt securing the upper arm to the suspension frame. Remove the arm (Fig. J:17).

Install the arm in the reverse order of removal. Secure the ball stud retaining nut with a new split pin.

BUMP RUBBERS - Replace

On earlier models the front suspension bump rubber is mounted on an extension lug above the upper suspension arm on each side. To renew the stop, simply pull it out of its location in the suspension frame, and press a new rubber into position (Fig. J:19). Later models have a bolt on bump rubber (Fig. J:18). Torque tighten retaining nut (see TIGHTENING TORQUES).

STUB AXLES - Checking for Distortion

Ensure that the brake disc run-out is within specification. Remove the road wheel, and observe the brake caliper at the point shown in Fig. J:18. Any signs of scoring or rubbing etc. can be attributed to a distorted wheel spindle.

Removal

1. Remove the front hub assembly, as described previously in this chapter.
2. Remove the bolts securing the brake splash shield (Fig. J:20). Extract the split pins, and remove the ball stud retaining nuts. Free the ball joint tapers from their stub axle locations, using a suitable joint separator tool (Fig. J:12).
3. Similarly, disconnect the steering rod end from the stub axle. Lift the upper suspension arm, detach the stub axle from the ball studs, and remove (Fig. J:21).

Installation

Install the stub axle in the reverse order of removal. Secure the ball stud retaining nuts with new split pins.

TIE-RODS - Remove

1. Jack up the front of the car, and fit chassis stands. Remove the road wheel.
2. Remove the two bolts and nuts securing the tie bar to the suspension lower arm.
3. Extract the split pin from the front end of the tie bar and remove the forward of the two locknuts securing the tie bar to the suspension frame. If fitted, disconnect the stabiliser bar connecting link from the tie bar.
4. Withdraw the bar from its forward mounting bracket, and remove (Fig. J:22). Slide the bush and spacer assembly off the front end of the bar.

NOTE: Later models rubbers are colour coded.
Front: Black
Rear: Yellow

5. A rubber bush is fitted in the mounting eye for the stabiliser connecting link. If the bush is worn, damaged or perished, it should be replaced. Cut the cone ends off the bush to permit easy removal. Fit the new bush in the eye using Bush Replacer Tool No. 14.002 in conjunction with a fly-press (Fig. J:26).

Refit

Install the tie bar in the reverse order of removal. Fit a new split pin to the front end of the bar. The castor angle MUST be checked and reset, if necessary, after replacing the tie bar.

STABILISER BAR - Remove

1. At each of the body side members in turn, remove the bolt securing the stabiliser bar mounting clip to the mounting bracket, and remove the clip and split rubber bush.
2. Remove the three bolts securing each mounting bracket to the body side-member (Fig. J:24).
3. Disconnect the bar ends from the suspension tie bars, by removing the unit, withdrawing the through bolt, and removing the connecting link sleeve and washers (Fig. J:25).
4. Remove the stabiliser bar from under the car.
5. If the rubber bushes in the ends of the stabiliser bar are worn, damaged, or perished, they should be renewed. Cut the cone ends off the bush to permit easy removal.
6. Fit the new bush in the eye, using Bush Replacer Tool No. 14.002 in conjunction with a fly-press (Fig. J:26).

Refit

Installation is a reversal of the removal procedure. Ensure that the split bushes are correctly aligned with the stabiliser bar mounting brackets before fitting the retaining clips and bolts.

Technical Data

Front Wheel Alignment:

***Castor:**

Pre 1974 level	$3^{O}9' \pm 0^{O}30'$
Post 1974 level	$2^{O}45' \pm 1^{O}0'$

***Camber:**

Pre 1974 level	$0^{O}37' \pm 0^{O}30'$
Post 1974 level	$2^{O}45' \pm 1^{O}0'$
*King pin inclination	$3^{O}35' \pm 0^{O}30'$
Toe-out on turns	19^{O} front lock for 20^{O} back lock $32^{O}18'$ front lock for 35^{O} back lock
Toe-in setting:	
Pre 1974 level	0 to 7 mm (0 to 0.28 in) Toe-in (to be set at 3.5 mm (0.14 in) Toe-in)
Post 1974 level	2 mm (0.08 in) Toe-out. to 4 mm (0.16 in) Toe-in

*These figures only apply when the vehicle is fitted with kerb height gauges on the front and rear suspension.

Steering

GENERAL
TOE-IN SETTING
TRACK ROD ENDS
STEERING GEAR REMOVAL AND INSTALLATION
STEERING GEAR ADJUSTMENTS
STEERING GEAR OVERHAUL
LOWER STEERING SHAFT
STEERING COLUMN
TECHNICAL DATA

GENERAL

The rack and pinion type steering gear is mounted on the front suspension sub-frame through rubber insulators. Movement of the steering wheel is transmitted by the steering column shaft through a flexible coupling to the helically-toothed pinion. On later models (from Feb '74) a larger coupling is fitted to give extra movement between the steering rack and column.

Rotation of the pinion causes the rack to move laterally, and the track rods, attached to the ends of the rack, transmit movement to the steering arms, and cause the road wheels to turn. The lock stops are built into the steering gear, and are not adjustable.

The rack rods are fitted with ball joints at either end. The inner ball joints are attached to the steering rack, and protected by rubber bellows. The outer ball joints are incorporated in the detachable track rod ends, and are protected by conventional gaiters. The steering arms are integral with the front wheel stub axle assemblies.

The steering column is collapsible, to lessen the possibility of injury should the vehicle become involved in an accident. The column consists of an outer energy absorbing jacket and an inner torque-transmitting shaft. The column assembly is attached to the instrument panel through a special one-way break-away bracket welded to the outer jacket. A steering column lock/ignition switch is incorporated in the R.H. side of the steering column assembly.

TOE-IN SETTING

Adjustment of the toe-in is achieved by altering the effective length of the track rods. Toe-in setting can only be accurately checked and adjusted after it has been determined that all other suspension alignment settings are to specification. Adjustment of the toe-in will also affect the wheel lock angles (toe-out on turns) If the toe-in setting is altered, the wheel lock angles MUST be rechecked when adjustment is completed.

The following method of setting the toe-in should only be used as a temporary measure after replacement of steering or suspension components. The suspension alignment settings, front wheel toe-in, and wheel lock angles should then be checked by an Authorised Dealer or Specialist who will have the necessary equipment.

1. Check tyre pressures.
2. Check wheel bearing adjustment.
3. Check steering and front suspension ball joints, bushes and mountings for excessive wear, looseness or tightness.
4. Rock car up and down several times to settle suspension.
5. Roll the car straight forwards on level ground, and stop it without using the brakes. It MUST NOT be moved backwards after this.
6. Measure the distance (A) between the inside edges of the front wheel rims at a point level with, and in front of the wheel axis.
7. Similarly, measure the distance (B) between the wheel rims at a point level with, but behind, the wheel axis. The difference by which "B" exceeds "A" will give the existing toe-in setting.
8. If adjustment is necessary, slacken the locknuts adjacent to the track rod end on both track rods.
9. Slacken the small clips on the steering gear bellows. Turn both track rods an equal amount in the same direction, until the correct toe-in setting is obtained.

NOTE: Both track rods should be approximately the same length after adjustment.

10. When adjustment is completed, tighten the locknuts at the track rod ends and the clips on the steering gear bellows.

TRACK ROD ENDS - Removal

1. Jack up the front of the car, and support on WHEEL stands (not chassis stands).
2. Slacken the locknut on the outer end of the track rod adjacent to the track rod end (Fig. K:1). Extract the split pin, and remove the castellated nut from the track rod ball stud.
3. Disconnect the ball stud from the steering arm, using a suitable extractor (Fig. K:2).

NOTE: Do NOT knock out the ball joint stud, as this is liable to damage the joint or associated parts. It is possible to shock the ball stud free by tapping on the steering arm around the stud.

4. Unscrew the track rod end, noting the number of turns required to free if from the rod.
5. Apply a smear of grease to the end of the track rod and screw on the new track rod end, using the same number of turns required to remove the old track rod end.
6. Connect the joint stud to the steering arm, fit and tighten the castellated nut, and secure with a new split pin.
7. Remove the wheel stands, and lower the car to the ground. Check and if necessary adjust the toe-in, as described previously.
8. Finally tighten the locknut at the track rod end.

STEERING GEAR - Removal

1. Jack up the front of the car, and support on WHEEL stands (not chassis stands).
2. Remove the clamp bolt and nut securing the flexible coupling to the pinion shaft (Fig. K:3).

NOTE: On later models the servicing procedure for the steering coupling is the same. It differs only in appearance see (Fig. K:3).

Remove the split pin and castellated nut, and disconnect the track rods from their steering arms, using a suitable extractor (Fig. K:2).

3. Release the lock tabs, and remove the four bolts securing the steering gear mounting clamps to the suspension sub-frame (Fig. K:5).
4. Detach the two "U" shaped mounting clamps. With-

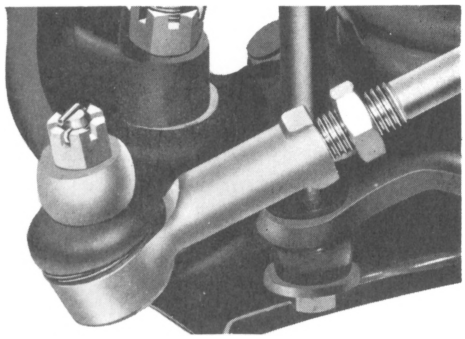


Fig. K:1 Track rod end and locknut

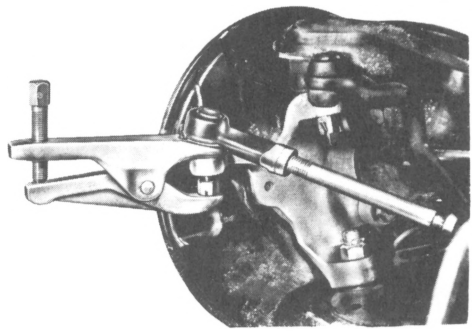
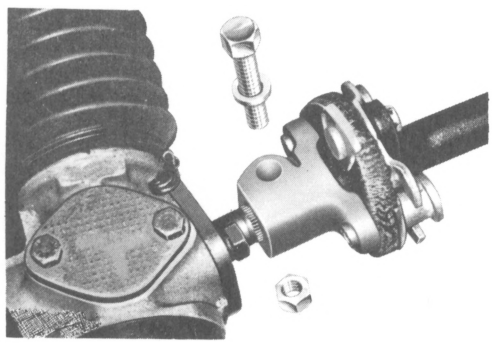
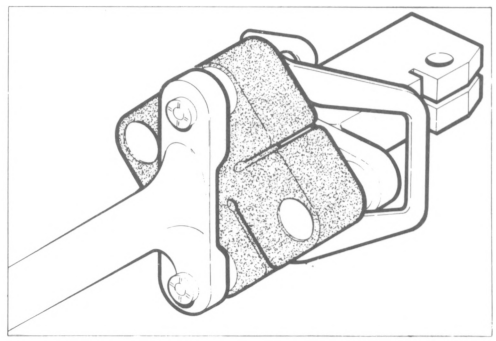


Fig. K:2 Separating track rod from steering arm

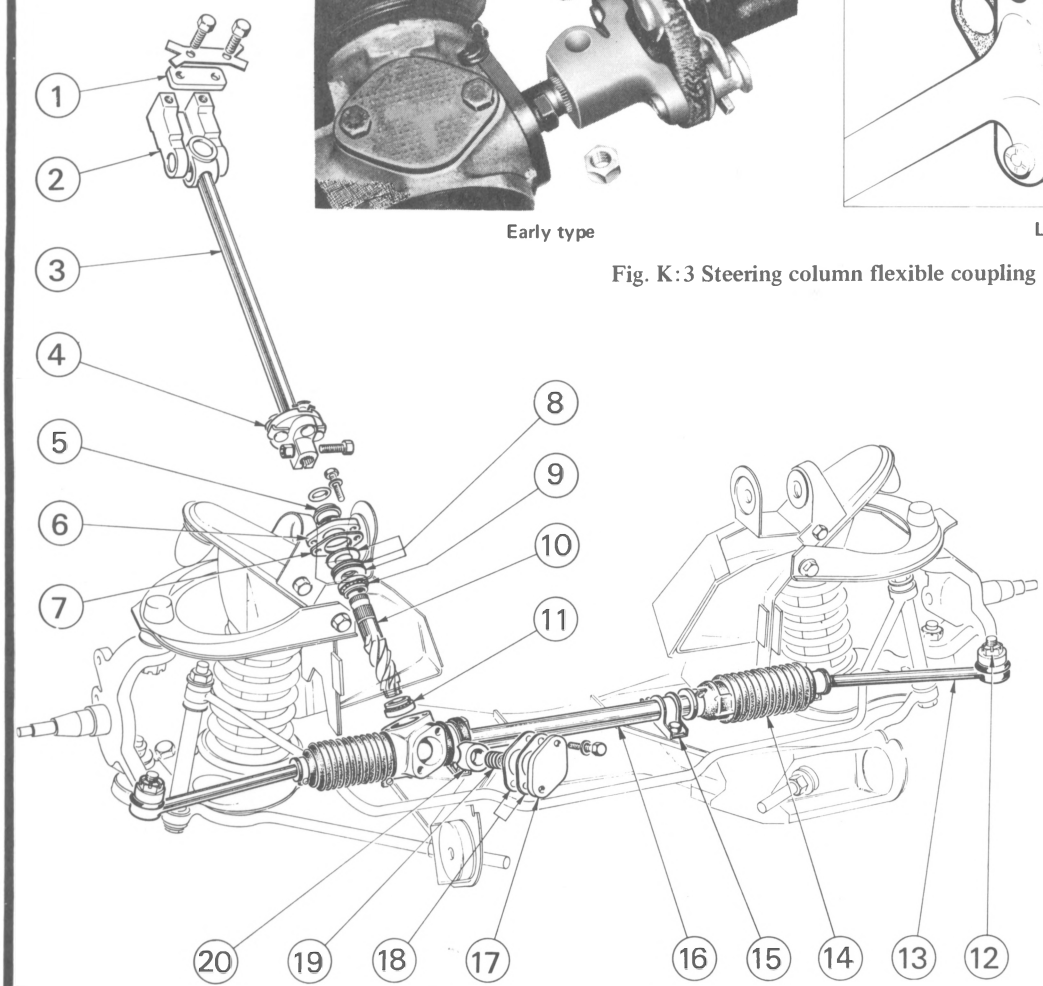


Early type



Later type

Fig. K:3 Steering column flexible coupling



1. *Clamp bar*
2. *Universal joint assembly*
3. *Lower steering shaft*
4. *Flexible coupling*
5. *Pinion cover seal*
6. *Pinion cover plate*
7. *Cover gasket*
8. *Pinion pre-load shims*
9. *Pinion upper bearing*
10. *Pinion shaft*
11. *Pinion lower bearing*
12. *Track rod outer ball joint*
13. *Track rod*
14. *Rack bellows*
15. *Mounting clamp*
16. *Rack housing*
17. *Slipper bearing cover plate*
18. *Slipper bearing shims*
19. *Slipper pre-load spring*
20. *Slipper*

Fig. K:4 Steering gear

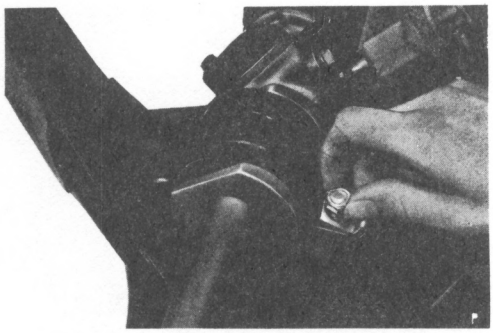


Fig. K:5 Detaching steering gear mounting clamps

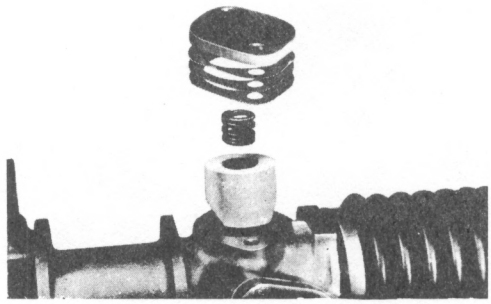


Fig. K:6 Rack slipper bearing assembly

Fig. K:7 Pinion bearing pre-load shims and cover plate

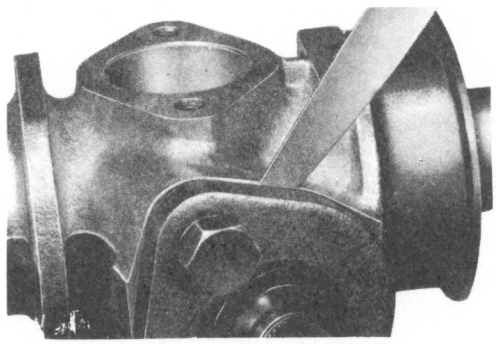


Fig. K:8 Measuring pinion cover to housing clearance

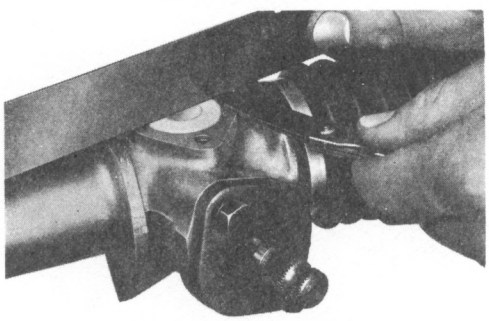


Fig. K:9 Measuring protrusion of rack slipper

Fig. K:10 Measuring pinion shaft turning torque

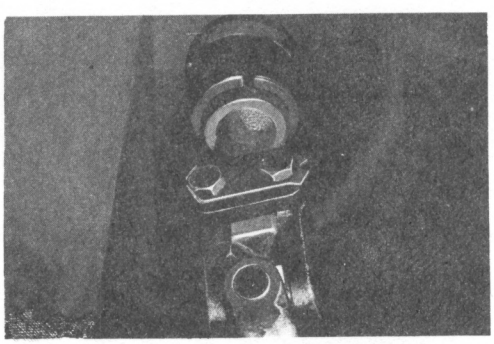


Fig. K:11 Steering column universal joint

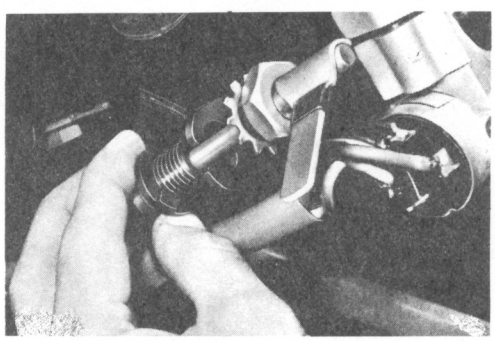


Fig. K:12 Removing choke control

draw the steering gear from the car.

NOTE: On some models, it will be necessary to remove the oil filter bowl to allow the steering gear to be withdrawn.

Installation

1. Check the condition of the steering gear mounting rubbers, and renew if necessary.
2. Set both the steering gear and the steering wheel in the straight-ahead position.
3. Position the steering gear on the car, align the mating splines on the flexible coupling and pinion shaft, and engage the coupling on the shaft.
4. Fit the "U" clamp in position on the steering gear, and secure them to the mounting brackets on the suspension sub-frame. Use new locking plates under the bolt heads. Tighten the bolts, and secure with the locking plate tabs.
5. Connect the track rod ends, to the steering arms, fit and tighten the castellated nuts, and secure with new split pins.
6. Fit the clamp bolts and nut to the flexible coupling, and tighten securely. Remove the wheel stands, and lower the car to the ground.
7. Check the toe-in and wheel lock angles. Check that the steering wheel is in its correct symmetrical position when the front wheels are in the straight-ahead position.

Adjustment

The steering gear must be removed from the car to carry out any adjustment. Two adjustments are possible on the steering gear: Pinion bearing pre-load and rack slipper bearing.

1. Mount the steering gear in a vice, with the pinion shaft positioned horizontally and the rack pre-load cover plate uppermost.
2. Remove the two bolts securing the cover plate, and lift off the plate, shim pack and gasket. Withdraw the slipper
3. Withdraw the slipper pre-load spring and slipper bearing (Fig. K:6). Similarly, detach the pinion bearing pre-load cover plate, shim pack, and gasket (Fig. K:7).

Pinion Bearing Pre-load

4. Fit a shim pack on the pinion bearing. The shim pack must contain at least two shims in addition to a 2.35 mm (0.093 (0.093 in) shim which must be fitted at the top of the pack.
5. Refit the cover plate without the gasket, and tighten the bolts down evenly. It is necessary to crush the shim pack in this manner to ensure that any grease or oil between the individual shims is expelled, otherwise a false reading will be obtained.
6. Slacken the cover plate bolts until the plate is only just contacting the shim pack, then measure the gap between the cover plate and the pinion housing (Fig. K:8).
7. This should be 0,28 - 0,33 mm (0.011 - 0.013 in). Take feeler blade measurements adjacent to confirm that the cover plate is parallel with the surface of the pinion housing.
8. If the clearance is outside these limits, alter the shim pack thickness until the correct gap is obtained. The shim pack must always contain at least two shims in addition to the 2,35 mm (0.093 in) shim.
9. When the correct shim pack thickness has been determined pack the pinion shaft seal with grease, and refit the cover plate and gasket. Coat the bolt threads with sealer before fitting and tightening to their specified torque.

Rack Slipper Bearing

10. Lubricate the slipper, and install it in the steering housing, pushing it fully home.
11. Using a straight-edge and a feeler blade, measure the distance by which the top of the slipper protrudes above the surface of the pinion housing (Fig. K:9). Note this dimension.
12. Assemble a shim pack (including the cover gasket) which is 0,152 - 0,013 mm (0.006 - 0.0005 in) greater in thickness than the previously measured dimension.

NOTE: It is important that the correct thickness of shim pack is obtained otherwise "knocking" or stiff steering may result.

13. Fit the slipper pre-load spring into the recess in the slipper. Ensure that the correct spring is fitted.
14. Fit the shim pack with the gasket adjacent to the cover plate, and refit the cover plate. Coat the bolt threads with sealer, then fit and tighten them to their specified torque.
15. Fit adaptor, Tool No. P.4030-7, on the pinion shaft, and assemble turning torque gauge, Tool No. CP 4030, to the adaptor (Fig. K:10).
16. Determine the torque required to start the pinion rotating. This should be 5.77 - 17.30 kg.cm (5 - 15 lb.in). If the turning torque is not within these limits, the shimming is incorrect, or these is some other malfunction with the steering gear (e.g. tight bearings, damaged gear teeth, lack of lubricant etc) which is increasing the friction level.

Steering gear-overhaul

In view of the complicated procedure this is a job best left to a main dealer, who will have the necessary tools and information required.

LOWER STEERING SHAFT

If the steering column flexible coupling or universal joint require to be replaced, the complete lower steering shaft assembly must be removed.

Removal

1. Remove the clamp bolt and nut securing the flexible coupling to the steering gear pinion shaft (Fig. K:3). Bend back the lock tabs, and remove the two bolts securing the clamp bar to the universal joint (Fig. K:11).
2. Remove the clamp bar, and separate the universal joint from the steering column upper shaft.
3. Draw the coupling flange off the pinion shaft, and remove the lower steering shaft assembly.

Installation

Installation is a reversal of the removal procedure. Ensure that the mating splines on the coupling flange and pinion shaft are correctly aligned, before fitting the flange on the shaft. The shaft has a single spline with four blocked serrations either side. The flange has corresponding grooves.

STEERING COLUMN - Remove Refit (Pre 1974)

1. Remove the retaining screw in the underside of the steering wheel, and detach the steering wheel embellishment, where fitted.
2. Remove the steering wheel retaining nut, and pull the wheel off the splined steering shaft. Remove the choke control knob.
3. Remove the screw and annulus, and split the two halves of the steering column shroud. Remove the choke control from its attachment bracket (Fig. K:12).
4. Disconnect the ignition switch and direction indicator assembly wiring looms. Remove the direction indicator switch. Slide the indicator cancelling cam and spring off the top of the steering shaft.

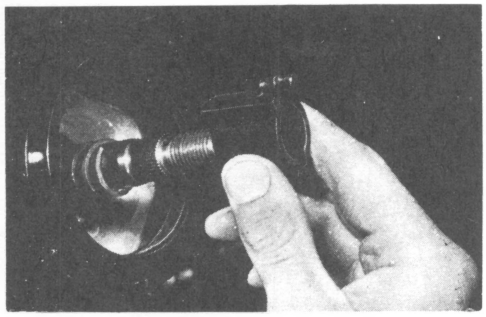


Fig. K:13 Fitting indicator cancelling cam

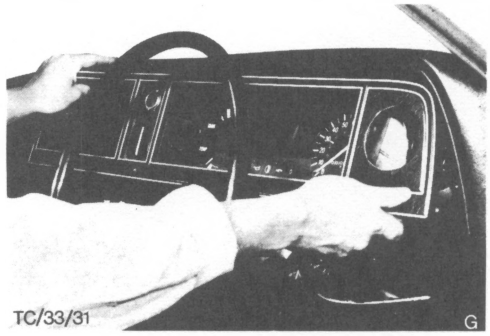


Fig. K:14 Removing bezel assembly

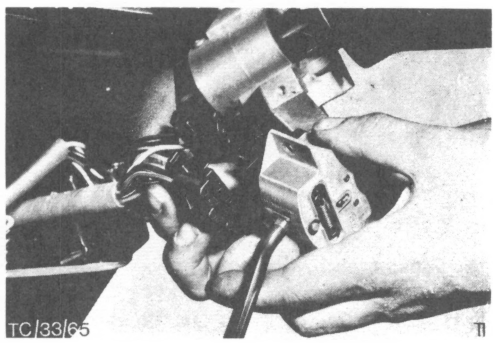


Fig. K:15 Removing switch assembly

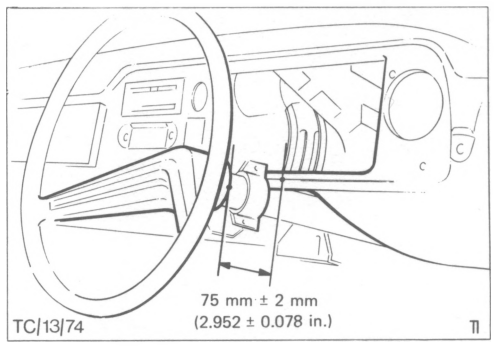


Fig. K:16 Installing steering column assembly

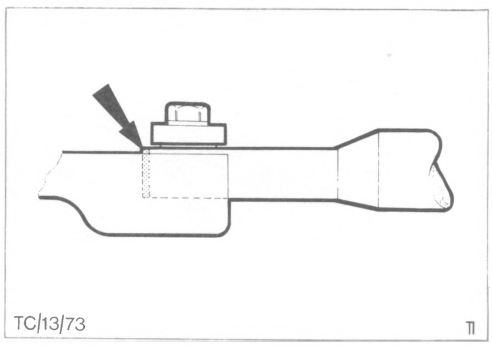


Fig. K:17 Column shaft alignment

1. *"Detrin" insert*
2. *Steering shaft*
3. *Upper bearing lower circlip*
4. *Upper bearing*
5. *Upper bearing top circlip*
6. *Upper bearing cover*
7. *Column retaining circlip*
8. *Plain washer*
9. *Mounting bracket*
10. *Collapsible outer tube*
11. *Lower bearing*
12. *Lower bearing cover*

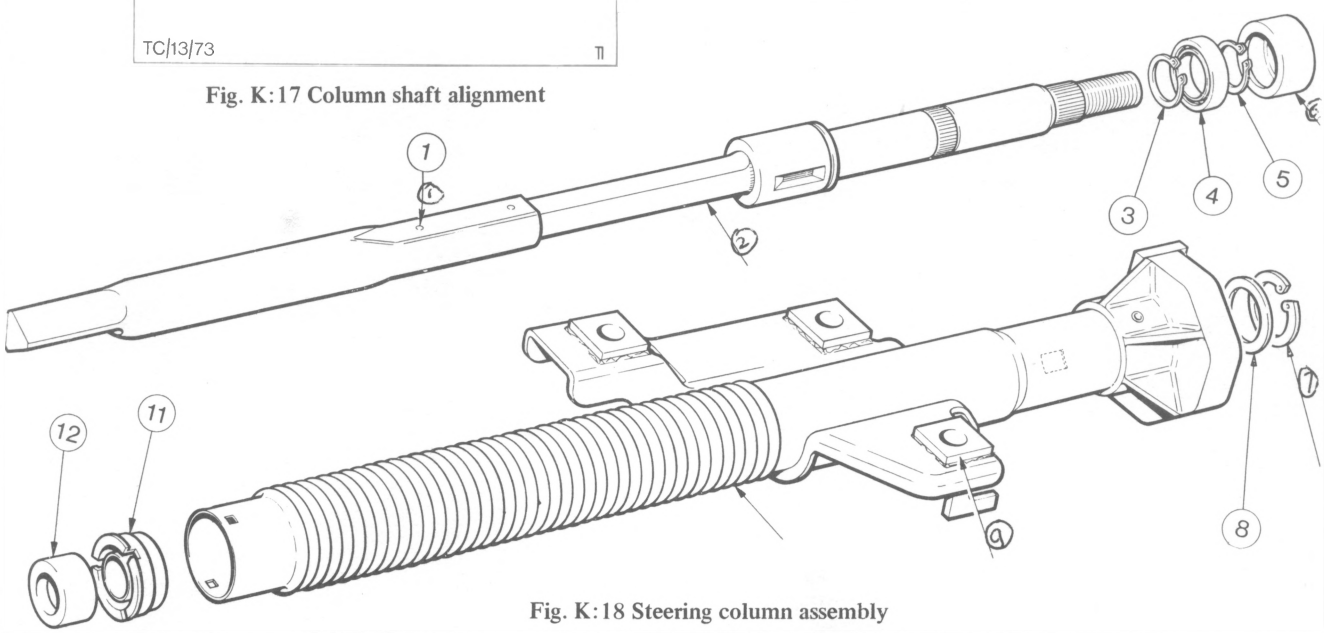


Fig. K:18 Steering column assembly

5. Disconnect the brake pedal return spring. Bend back the lock tabs, remove the two retaining bolts, and remove the clamp plate securing the universal joint to the lower end of the steering column shaft (Fig. K:11).

6. Remove the column assembly mounting bolts, and withdraw the assembly from the car.

Install the column in the reverse order of removal, with special note to the following points.

1. Ensure that the grommet at the bottom of the column locates correctly in the dash panel. When fitting the indicator cancelling cam, the ear on the cam must be adjacent to the cancelling lever on the indicator switch when the road wheels are in the straight ahead position (Fig. K:13).

2. Set the front wheels in the straight ahead position and align the steering wheel before engaging it with the splines on the steering shaft and the lug on the cancelling cam. Check that the indicators cancel correctly.

STEERING COLUMN - Remove Refit (1974 on)

1. Disconnect the battery.

2. Bend back the lock tabs on the flexible coupling clamp plate. Loosen both bolts, remove one, and swing the clamp plate aside.

3. Remove the screws from the steering column lower shroud and remove. Unclip the upper half of the steering column shroud.

4. Pull off the instrument panel light switch knob and radio control knobs.

5. Remove the three upper and three lower screws retaining the instrument cluster and bezel.

6. Ease the bezel assembly outwards from the dash panel and disconnect the two main loom multiconnectors from the back of the instruments.

7. Disconnect the three wires connected to the cigar lighter, one wire is the bulb holder for the cigar lighter illumination.

8. Disconnect the multi-connector loom plugs from the hazard flasher switch and the heated rear window switch if fitted.

NOTE: Pull the bezel assembly square of the dash panel. Tilting the panel will not allow the bezel to clear the steering column switch bracket (Fig. K:14).

9. Disconnect the speedometer cable and remove the instrument cluster and bezel assembly.

10. Remove the lower dash insulation panel.

11. Remove the bolts that hold the wiper switch and light switch in position. Un-plug the loom connector and detach the switch assembly (Fig. K:15).

12. Pull off the section of air ducting that traverses the column.

13. Remove the two screws and detach the loom block from the ignition switch (Fig. K:15).

14. Remove the clamp bolts from the steering column bracket at the instrument panel and pedal box locations, lower the column and allow the wheel to rest on the front seat.

15. Remove the steering column from the vehicle.

Refit the steering column in the reverse order of removal with the following observations:

16. Ensure that the column seal in the floor pan is in good condition.

17. Secure the column loosely to the instrument panel and pedal box.

18. Manoeuvre the column as necessary to achieve the dimensions shown in Fig. K:16 at the same time positioning the column centrally in the depression on the lower edge of the instrument panel.

19. Tighten the column bracket bolts to 2.4 to 3.0 kgm (18 to 22 lb.ft.), 1.7 to 2.4 kgm (12.2 to 17.2 lb.ft.) instrument panel 2.4 to 3 kgm (18 to 22 lb.ft) and the pedal box 17 to 24 kgm (12 to 17 lb.ft)

NOTE: The 1974 Cortina sealing plug in the end of the column shaft is increased in length and colour coded white. Similarly, the flexible shaft used is provided with a white identification code at its centre.

20. Position the flexible coupling on to the shaft, swing the plate into position and start the bolt previously removed. Leave the two bolts loose at this stage.

21. With the car on the road wheels check that the whole of the white sealing plug is visible beyond the lower end of the clamp plate. And that the rubber segments in the coupling are correctly aligned. (Fig. K:17). Tighten the bolts to 1.7 to 2.4 kgm (12 to 17 lb.ft).

NOTE: The clamp plate must not cover any part of the plug. If the minimum acceptable engagement of the shaft is not met with the assembled measurement of 75 mm (± 2 mm) (2.9 in ± 0.8 in) then all the associated parts and assembly conditions must be rechecked.

Technical Data

STEERING

Steering ratio	18,7 : 1
Turns lock to lock	3,7
Turning circle-between walls	10,7 m (35.1 ft)
between kerbs	9,7 m (31.8 ft)
Max. turning angle-outer wheel	38°48'
Inner wheel	35°36'
Front wheel toe-in	3,9 mm (0.16 in)
Desired limits	0 to 6,3 mm (0 to 0,25 in)
Lubricant type	SAE 90 EP Hypoid oil (SMZC-1012-A)
capacity	0,14 litres (0.25 Imp Pts.)

PINION BEARING SHIMS

Steel	0,13 mm (0.005 in)
	0,19 mm (0.007 in)
	0,25 mm (0.010 in)
Buna coated flexoid	0,254 mm (0.010 in)

RACK SLIPPER BEARING SHIMS

Steel	0,127 mm (0.005 in)
	0,19 mm (0.007 in)
	0,25 mm (0.010 in)
	0,38 mm (0.015 in)
Buna coated flexoid	0,254 mm (0.010 in)

Brakes

GENERAL
HYDRAULIC SYSTEM OVERHAUL
FRONT BRAKES
REAR BRAKES
HANDBRAKE
MASTER CYLINDER
PRESSURE DIFFERENTIAL VALVE
BRAKE SERVO UNIT
BLEEDING THE BRAKES
TECHNICAL DATA

GENERAL

All models are fitted with disc front brakes and drum rear brakes. The front brake calipers are of the fixed type with twin opposed pistons and automatic pad-wear compensation, and mounted at the rear of the brake disc (trailing caliper). The brake discs are bolted to the inboard face of the front hub assemblies.

The rear brakes are of the leading and trailing shoe type, with one double-acting wheel cylinder. A "self-adjust" mechanism which automatically compensates for wear of the shoe lining material, is incorporated in the drum brake assemblies. The mechanism consists of a self-adjusting push rod and ratchet assembly, and an actuating link attached to the handbrake relay lever.

Some later 1600cc models are fitted with foot brake operated self adjusting rear brakes. Identification is by a horizantally fitted tag on the rear axle casing.

A dual-line hydraulic system provides separate hydraulic systems for the front and rear brakes. Failure in either braking circuit will activate the differential valve and switch assembly, and illuminate the warning light on the instrument panel.

The tandem master cylinder is mounted on the engine compartment bulkhead and is operated by the brake pedal through a push rod. Where a brake servo is fitted, the unit is mounted on a bracket attached to the bulkhead and the master cylinder is mounted directly on the servo. The booster is of the suspended vacuum type, utilising engine inlet manifold depression for its operation.

The handbrake control lever may be either floor or dash-mounted, and operates mechanically on the rear wheels through a cable linkage. Where the lever is of the dash mounted type, two cables are used, and an additional relay lever is incorporated in the linkage between the front and rear cable.

HYDRAULIC SYSTEM

Overhauling any components of the hydraulic system, should be carried out under conditions of scrupulous cleanliness. Clean all dirt and grease from the exterior of components before removal or dismantling.

1. After dismantling, wash all parts in clean brake fluid. Do NOT use mineral based oils such as petrol, paraffin, or carbon tetrachloride. Blow out all internal passages with compressed air.
2. Inspect the piston and cylinder bore surfaces for scores, ridges, or corrosion. The unit must be discarded if any of these conditions are present.
3. It is recommended that only new seals be used when reassembling. These are generally available in the form of a repair kit containing all the necessary parts required for overhaul.
4. All seals should be inspected carefully before fitting, even if new. Check that the sealing lips are perfectly formed, conventric with the bore of the seal, and free from "knife-edges" surface blemishes or marks.

FRONT BRAKES - Inspection

1. The front wheel must be removed to allow inspection of the brake pads. Check the pad lining for wear, by measuring the distance between the face of the pad backing plate and the adjacent contact face of the brake disc. If less than 3.2 mm (0.125 in) and never less than 1,6 mm (0.063 in), the pads must be replaced.
2. Inspect the pad linings for grease or brake fluid contamination. If present, the pads should be replaced. Grease may indicate a defective hub grease seal, and steps should be taken to inspect, and rectify the fault before fitting new pads. Brake fluid may indicate a defective caliper piston seal, and similar remedial steps should be taken. Always replace BOTH pads at BOTH front wheels to maintain braking balance.

Brake pad-replacement

NOTE: The brake pads should be removed only when cold. If hot after use, they must first be allowed to cool down.

1. Remove the spring clips at the inboard end of the pad retaining pins (Fig. L:3) and withdraw the two pins from the caliper (Fig. L:4).
2. If difficulty is encountered in removing the pins, they can be tapped out of their locations, using a suitable pin drift, but care should be taken to avoid damaging the caliper.
3. Withdraw the brake pads and shims from the caliper, using long-nose pliers, if necessary (Fig. L:5).

NOTE: If the brake pads are not being renewed, they should be suitably marked, to ensure they are refitted in their locations.

4. On some models an alternative brake pad installation is used (Fig. L:2). In this case, bend straight the legs of the pad retaining pins. Withdraw the pins from the inboard side of the caliper, and remove the brake pads, shims and anti-rattle clips, as an assembly.
5. Detach the clip, and separate the shim from the brake pad.
6. Brush or blow any dust or dirt out of the calipers. Press both pistons back into their cylinder bores. Do not lever against the brake disc during this operation.
7. The fluid level in the master cylinder reservoir will rise when the pistons are pressed back. It may be necessary to syphon off the excess fluid to prevent it overflowing.
8. Inspect the rubber dust cover fitted to each piston, and replace if punctured perished, or otherwise unserviceable.
9. Clean the friction surfaces of the disc, and ensure that they are free of grease, oil, or brake fluid.
10. Check that the replacement pads are of the correct type. Fit the pads and shims in the caliper, ensuring that both are correctly fitted (Fig. L:5). The shims may be fitted either way up.
11. Check that the pads are free to move easily in the caliper recess. Fit the pad retaining pins from the outboard side (Fig. L:4) and secure them in position with the spring clips. The pins must NOT be forced into their locating holes.
12. On models with the alternative brake pad installation, coat the shims with a thin film of shim grease (Part No. ESEA MIC 1014) on each side, and assemble the shim, pad and anti-rattle spring, as shown in Item 5 Fig. L:2. The arrow incorporated in the shim must point in the direction of the wheel forward rotation.

1. *Shim*
2. *Brake pad*
3. *Spring clip*
4. *Bleed valve*
5. *Calliper body*
6. *Pad retaining pin*
7. *Dust cover retainer*
8. *Dust cover*
9. *Piston*
10. *Piston seal*

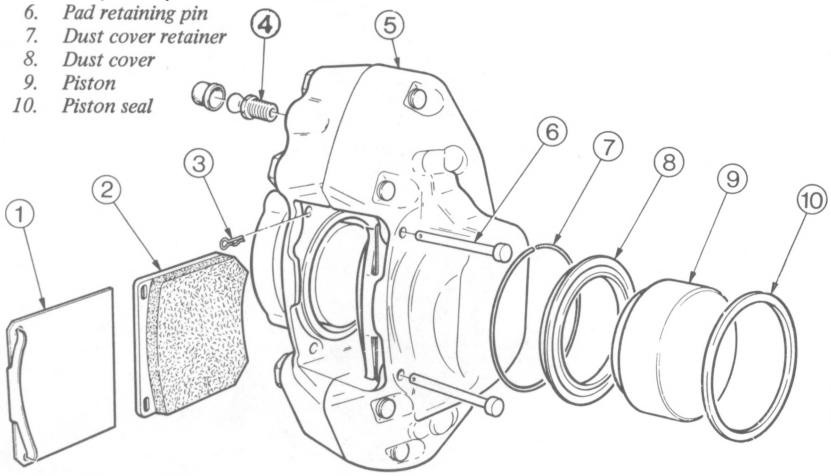


Fig. L:1 Exploded view of brake caliper

1. *Anti-rattle clip*
2. *Shim*
3. *Pad retaining pins*
4. *Brake pad*
5. *Correct assembly of clip to pad and shim*

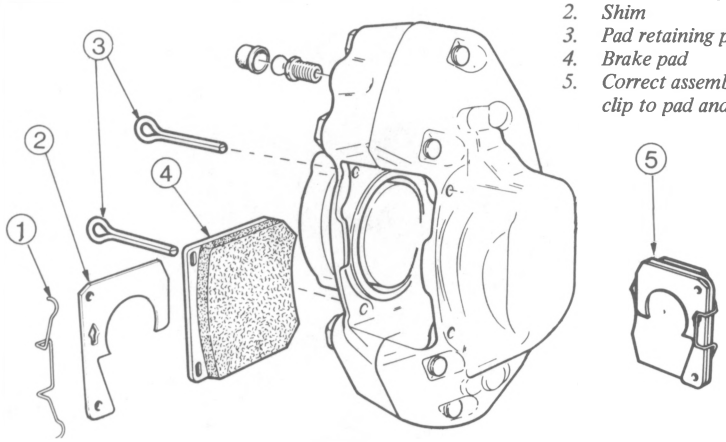


Fig. L:2 Alternative brake pad installation

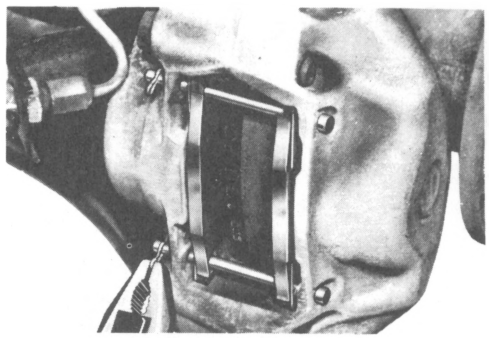


Fig. L:3 Removing pin securing clips

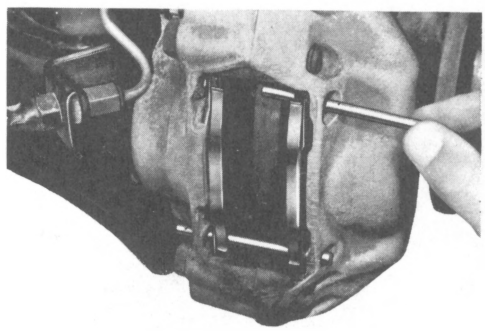


Fig. L:4 Withdrawing pad retaining pins

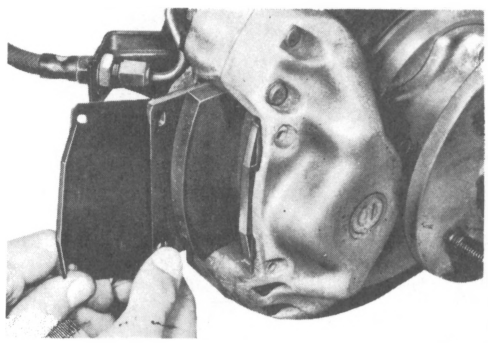


Fig. L:5 Removing brake pad and shim

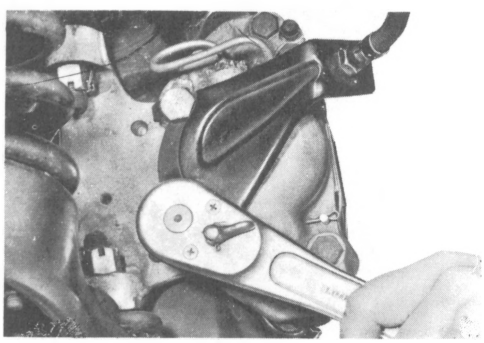


Fig. L:6 Caliper installation

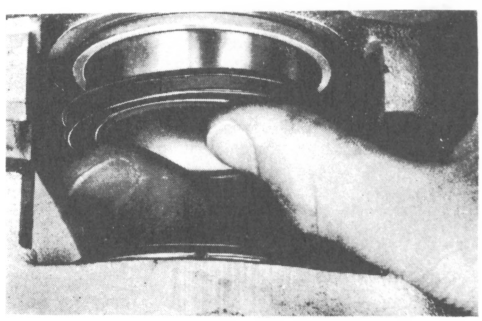


Fig. L:7 Installing caliper piston

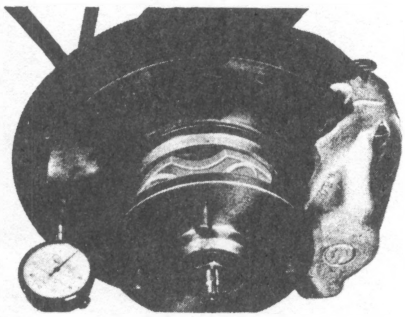


Fig. L:8 Checking brake disc run-out

Fig. L:9 Separating brake disc from front hub

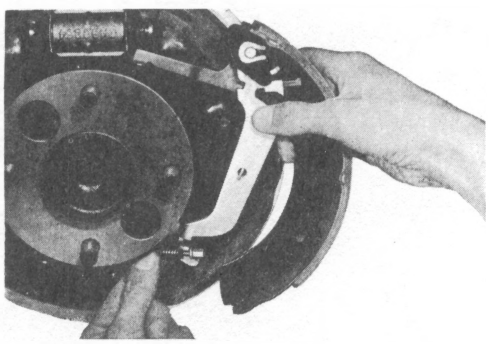


Fig. L:10 Removing trailing brake shoe

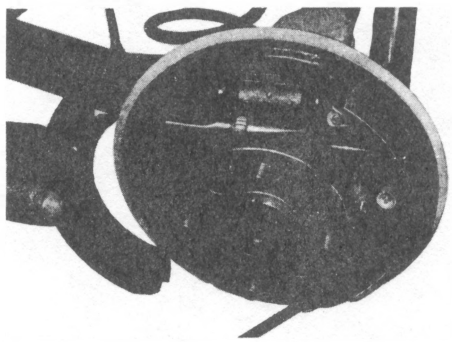


Fig. L:11 Removing leading brake shoe

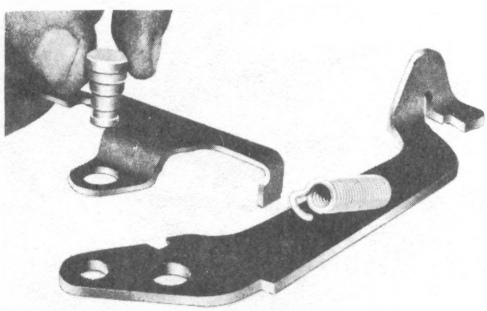


Fig. L:12 Handbrake relay lever and adjuster lever assembly

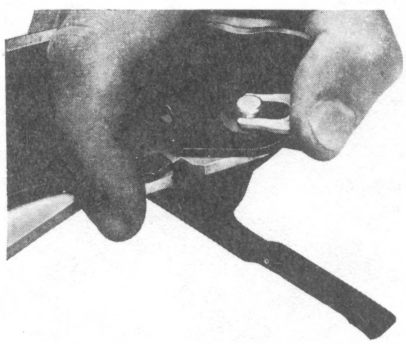


Fig. L:13 Assembling relay lever to secondary brake shoe

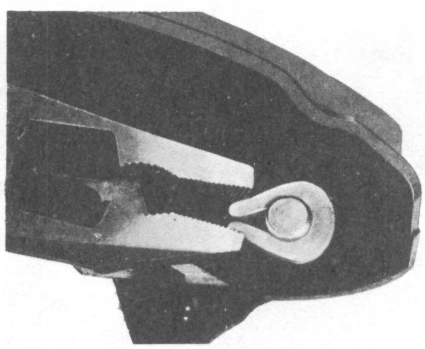


Fig. L:14 Securing relay lever "U" clip

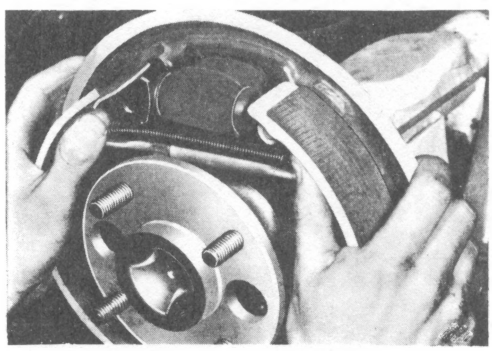


Fig. L:15 Brake shoe installation

13. Fit the pad assemblies in the caliper, insert the pad retaining pins from the inboard side, and secure them in position by spreading the legs.

14. Depress the brake pedal several times to bring the brake pads into their correct operating clearance with the disc. Refit the road wheel.

15. Finally, when the operation has been completed on both wheels, lower the car, check the fluid level in the master cylinder reservoir, and top up if necessary.

NOTE: New brake pads require a "running-in" period of approx. 600 Km (400 miles) during which emergency braking from high speeds should be avoided.

Caliper - Remove/Refit

NOTE: Do NOT attempt to remove the caliper when it is hot. Allow it to cool first.

1. Remove the brake pads and shims from the caliper, as described above. If it is intended to overhaul the caliper assembly depress the brake pedal to bring the caliper pistons into contact with the brake disc, to facilitate piston removal.

2. Disconnect the hydraulic pipe from the union on the hose bracket, after first cleaning all dirt from the surrounding area.

3. Fit a suitable blanking plug to each open end, to prevent loss of fluid and the ingress of dirt. Release the locking plate tabs, remove the two bolts securing the brake caliper to the stub axle upright, and lift the caliper assembly off the brake disc. (For later models see FRONT SUSPENSION)

Refitting is a reversal of the removal procedure. Use a new locking plate, and tighten the caliper mounting bolts to their specified torque. Finally, bleed the brakes, as described later in this section.

Overhaul

1. Partially withdraw one piston from its bore in the caliper body.

2. Remove the spring retainer securing the rubber dust cover and detach the dust cover from its locating groove in the piston skirt.

3. Completely remove the piston from its cylinder. Removal can be facilitated, by injecting compressed air or low hydraulic pressure into the fluid connection.

4. Remove the piston sealing ring from the groove in the cylinder bore, using a suitably blunt instrument (e.g. a plastic needle). Take care not scratch the bore. Repeat for the other cylinder.

NOTE: The two halves of the caliper body must not be separated.

5. Clean and inspect the components, as described in "HYDRAULIC SYSTEM" earlier in this section, and replace as necessary.

6. Lubricate the cylinder bores, pistons and piston sealing rings with clean brake fluid.

7. Fit a new piston seal to the annular groove in one cylinder bore.

8. Fit the dust cover to the piston, with the inner edge located in the annular groove in the piston skirt. Insert the piston, crown first, into its bore, and push it fully home (Fig. L:7).

9. Locate the outer edge of the dust cover on the caliper body at the top of the cylinder, and secure it to the caliper with the spring retainer. Repeat for the other cylinder.

Brake Disc

The brake disc run-out can be checked with a dial gauge.

1. Disconnect the track rod, and attach the dial gauge to the steering arm.

2. Position the indicator with the stylus in contact with the face of the brake disc near its outer edge (Fig. L:8). The run-out must not exceed 0.089 mm (0.0035 in). If a reading in excess of this is obtained check the hub bearing adjustment and bearing condition before replacing the brake disc.

3. Remove the dial gauge, and reconnect the track rod to the steering arm. Secure the track rod castellated nut with a new split pin.

The brake disc is bolted to the inboard face of the front hub assembly. Remove and install the disc and hub assembly, as described in the FRONT SUSPENSION section.

4. Inspect the disc friction surface. Moderate scoring is permissible, but heavy wear, scoring, grooving, or distortion necessitates regrinding or replacement of the disc. No more than 0,635 mm (0.025 in) may be removed from any one surface of the disc when regrinding.

5. To separate the disc from the hub, release the locking tabs, and remove the four securing bolts (Fig. L:9). Discard the locking plates.

6. Before reassembling the disc to the hub, ensure that the mating faces on both the hub and disc are thoroughly clean.

7. Tighten the four retaining bolts to their specified torque, and bend up the tabs on the new locking plates to secure. Check the disc run-out, after installing the hub assembly on the stub axle.

REAR BRAKES - Inspection

The linings should be inspected for wear at 10,000 km (6.000 mile) intervals.

1. Raise the rear of the car, and support the axle on chassis stands. Remove the road wheel.

2. Ensure that the handbrake is fully released, then remove the brake drum. If the brake shoes are fouling the drum and preventing removal, remove the handbrake cable from the underbody brackets, and then remove the adjustment plunger assembly from the backplate (Fig. L:20).

3. Clean out the brake drum and lining, using a soft brush or clean cloth. Inspect the thickness of the linings. There should be at least 1.52 mm (0.06 in) depth of lining material, otherwise they should be renewed.

4. Inspect the linings for oil or brake fluid contamination. If present, the linings should be renewed. The presence of oil may indicate a defective axle shaft seal, and steps should be taken to inspect and rectify the fault before fitting new linings.

5. Brake shoes should be replaced in axle sets (i.e. BOTH shoes of BOTH rear brakes) to ensure correct functioning of the self-adjusting feature of the rear brakes.

It is recommended that exchange brake shoe assemblies be fitted as replacements, since the linings on these are correctly ground to match brake drum.

6. Inspect the wheel cylinder for signs of leakage. If present, the cylinder should be overhauled, or replaced immediately.

7. Examine the friction surface of the brake drum for scoring. Light scoring is permissible but serious scoring will increase lining wear, and in this case, the drums should be machined true, or replaced. If the wear pattern on the brake linings is uneven across the width of the lining, inspect the drum for "belling", and the back plate for distortion. Where one drum requires machining, it is advisable to cut down the drum on the opposite brake to the same size.

Replacement

8. Remove the brake shoe hold-down spring, one at each shoe, by depressing the retaining washer, turning it through 90°, and pulling off the washer and spring.

9. Withdraw the pins from the rear of the back plate.

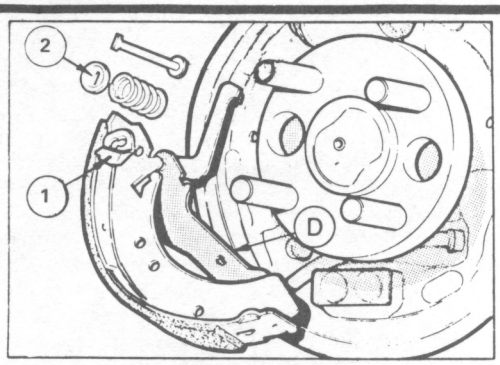


Fig. L:16 Removing handbrake lever

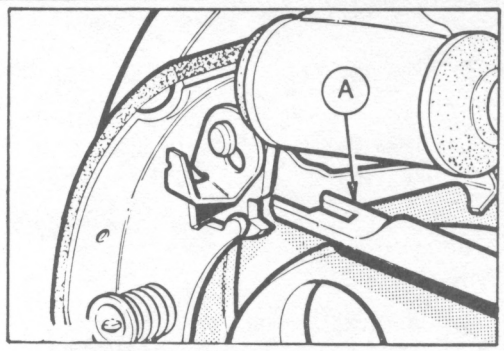


Fig. L:17 Rear brake replacement

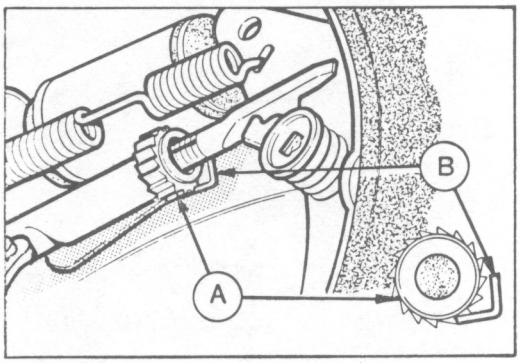


Fig. L:18 Brake adjustment

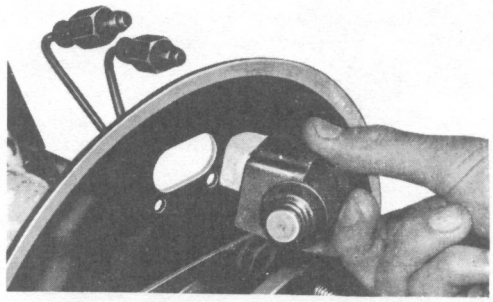


Fig. L:19 Removing wheel cylinder

1. *Shoe hold-down pin*
2. *Back plate*
3. *Wheel cylinder*
4. *Ratchet operating lever*
5. *Handbrake relay lever*
6. *Self-adjusting push rod and ratchet*
7. *Leading (rear) brake shoe*
8. *"U" clip*
9. *Trailing (front) brake shoe*
10. *Hold-down spring and washer*
11. *Handbrake cable retracting spring*
12. *Handbrake adjustment plunger*

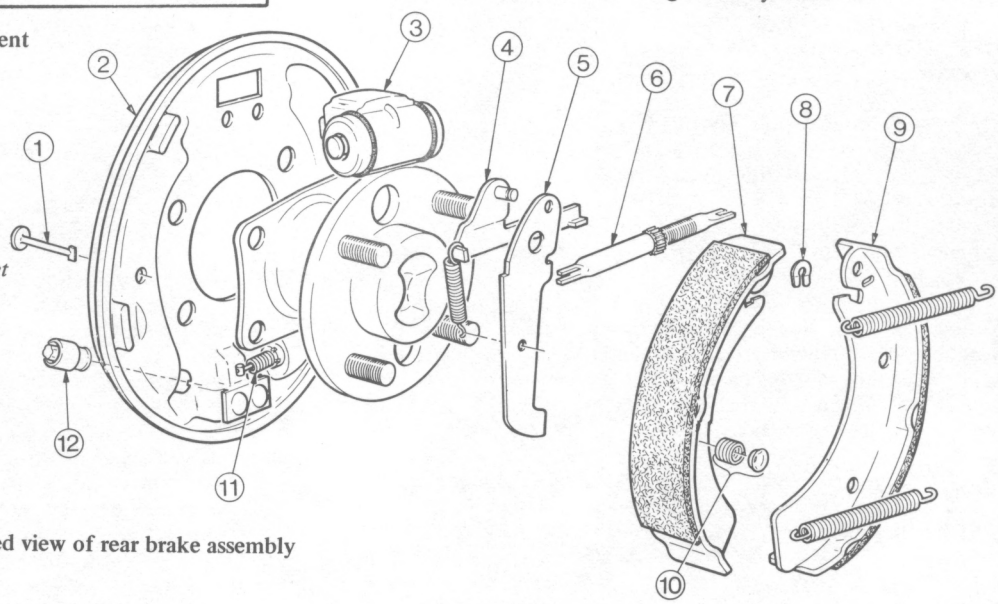


Fig. L:20 Exploded view of rear brake assembly

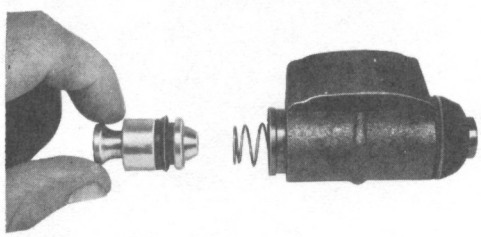


Fig. L:21 Removing wheel cylinder piston

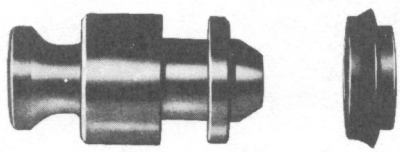


Fig. L:22 Wheel cylinder piston and seal

Disengage each shoe from its location slot in the fixed pivot, and lift away from the wheel cylinder.

10. Disconnect the shoe retracting springs, and remove the front shoe (Fig. L:10). Remove the self-adjusting push-rod and ratchet assembly.

11. If not already removed, completely remove the handbrake cable from the underbody brackets. Disconnect the handbrake cable from the relay lever on the rear shoe, and remove the rear shoe assembly (Fig. L:11).

12. Prise open the "U" clip, and detach the relay lever assembly from the rear shoe.

13. If required, the ratchet operating lever can be separated from the handbrake relay lever, by disconnecting the tensioning spring and pushing out the pivot pin (Fig. L:12).

14. Fit a brake cylinder clamp or rubber band to the wheel cylinder, to retain the pistons in position.

NOTE: If oil or brake fluid contamination is present on the back plate or brake drum, it should be cleaned off once the cause had been determined and rectified. Oil contamination on the back plate and other removed components, except the brake drum, should be cleaned off with mineral spirit (e.g. petrol paraffin). Brake fluid contamination can be removed using commercial alcohol or methylated spirit. Finally, clean all parts especially the brake drum, with a solution of soap and water.

15. Inspect the shoe retracting springs for fractures, stretching or evidence of over-heating indicated by discolouring. When fitting new springs, ensure that the correct replacements are obtained.

16. Check that the ratchet wheel on the self-adjusting push rod is not worn, and that the wheel is free to turn on the push rod.

17. Apply a smear or brake grease (EM - 1C - 18) to the ratchet wheel face and push rod threads. Also apply a small amount of brake grease to the shoe hold-down pins, support points on the tips of the brake shoes and to the brake shoe support pads and shoe pivots on the back plate.

18. If dismantled, reassemble the ratchet operating lever to the handbrake relay lever, and secure with the pivot pin.

19. Reconnect the tensioning spring. Assemble the relay lever assembly to the rear brake shoe, and secure with a new "U" clip (Fig. L:13).

20. Close the ends of the clip with pliers (Fig. L:14). Apply a small amount of brake grease to the lever pivot and contact points.

21. Remove the clamp or rubber band from the wheel cylinder. Fit the retracting springs and adjuster push rod to the brake shoes. Ensure that the springs are correctly assembled to the shoes.

22. Locate the rear shoe on the fixed pivot on the back plate, and prise the front shoe into position (Fig. L:15).

23. Connect the handbrake cable to the relay lever, and re-attach the cable to the under body. The relay lever should not be fouling the adjustment plunger.

24. Secure each shoe to the backplate with the hold-down pin, spring, and washer. Compress the spring, and turn the washer through 90° to lock it in position. Check to ensure that the shoes are firmly seated.

25. Wind the ratchet wheel to completely eliminate all free-play in the push rod, and check that the ratchet operating lever locates correctly on the ratchet wheel.

26. Install the brake drum. It may be necessary to remove the ring of rust around the rim of the drum, to facilitate installation. Refit the road wheel

27. Apply the foot brake two or three times to centralise the brake shoes, then operate the handbrake lever until the clicking sound of the adjuster mechanism ratchet stops. Check the operation of the brakes on road test.

REAR BRAKE SHOES (1600 from Jan 74)

As stated in the GENERAL introduction at the beginning of this section some models are fitted with footbrake operated rear adjusting brakes. The handbrake adjustment is the same. Removal of the rear brake linings is the same procedure as previously stated with the following exceptions.

1. Remove the handbrake lever from the rear shoe (Fig. L:16) by sliding the retaining bracket from hand brake lever pivot pin (1).

NOTE: The alternative type brakes are identifiable as having a green two coil spring, a red single coil spring, and a bright metal spring anchoring bracket.

2. Before reassembly check that the hand brake stop assembly is not damaged or stiff in its housing.

3. Reassemble the rear brakes as follows. With the operating parts lubricated. Set the adjusting ratchet wheel to its minimum length.

4. Fit rear shoe to hand brake lever pivot pin and secure with the retaining bracket (Fig. L:16.1).

5. Position shoe against lower location and wheel cylinder piston. Position hand brake lever over stop assembly and fit retaining spring and pin (2).

6. Locate adjusting lever over brake shoe and handbrake operating lever. Note that the longer fork goes against the brake shoe (Fig. L:17).

7. Fit front shoe to adjusting lever fork, wheel cylinder and lower pivot location.

8. Fit the springs. Upper to the front and then rear shoe retaining bracket. Make certain tag is located in the cut out in shoe.

9. With both springs fitted, expand the adjusting lever so that there is no slack movement (Fig. L:18.1). Bring adjusting lever to its correct position (2) relative to the adjusting ratchet wheel (3).

10. Fit brake drums and wheels. Pump footbrake several times to bring adjustment lever to its correct position.

NOTE: Pedal travel should lessen as brakes are adjusted. Carry on pumping brake pedal until pedal travel is constant over several applications.

Wheel Cylinder Overhaul

NOTE: The wheel cylinder need not be removed from the brake back plate to inspect or overhaul it. Removal is only necessary when the cylinder must be replaced.

1. The wheel cylinder should be dismantled and inspected if signs of fluid leakage are evident, or if signs of overheating are present, when relining the brakes, or if the car has covered a mileage of 48,000 km (30,000 miles). An overhaul kit should be obtained, and all the parts contained in the kit fitted when overhauling the cylinder.

2. Remove the brake shoes, as described previously. Clean all dirt, grease, and oil from the exterior of the cylinder and the surrounding area.

3. Remove the boot retainers, detach the rubber boots from the ends of the cylinder, and withdraw the assemblies. (Fig. L:21).

4. Remove the piston return spring from the cylinder bore. Remove the rubber seal from each piston.

5. Clean and inspect the components as described in "HYDRAULIC SYSTEM" earlier in this section, and replace as necessary.

6. Lubricate the cylinder bore, pistons, and piston seals with clean brake fluid. Fit the seals to the pistons with the flat face of the seal adjacent to the piston central shoulder (Fig. L:22).

7. Fit the return spring in the wheel cylinder bore. Insert

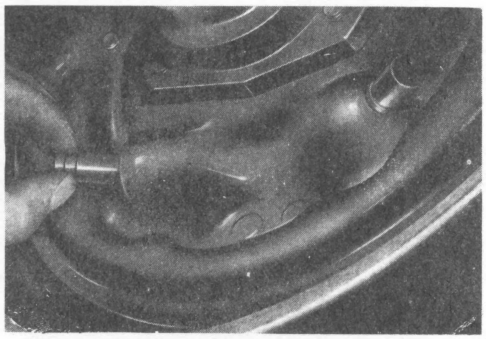


Fig. L:23 Handbrake adjustment plunger

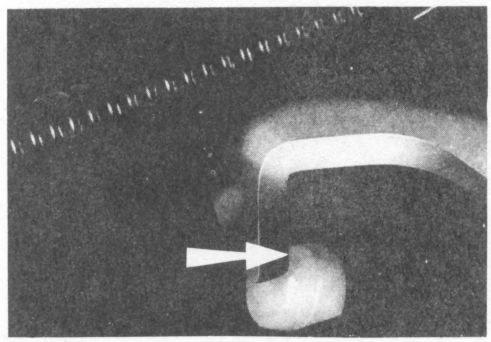


Fig. L:24 Check clearance between relay lever and plunger at point indicated

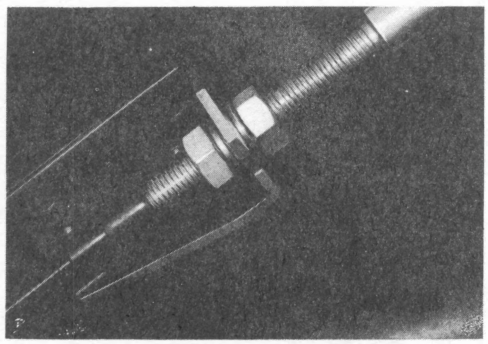


Fig. L:25 Front cable adjustment - Dash - mounted handbrake

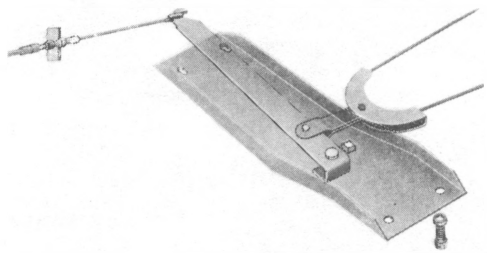


Fig. L:26 Handbrake relay lever assembly - Dash - mounted handbrake

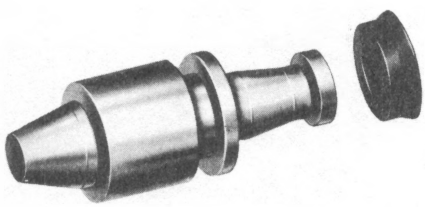


Fig. L:27 Master cylinder secondary piston and piston seal

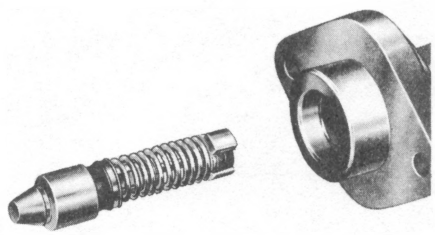


Fig. L:28 Master cylinder secondary piston and recuperating valve assembly

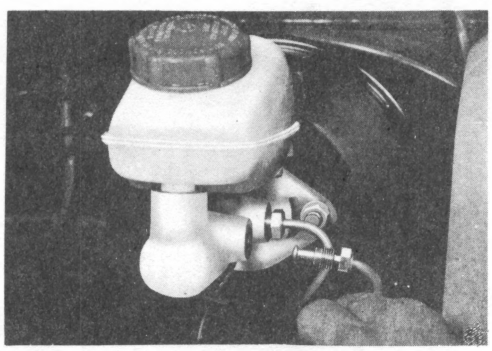


Fig. L:29 Master cylinder fluid connections

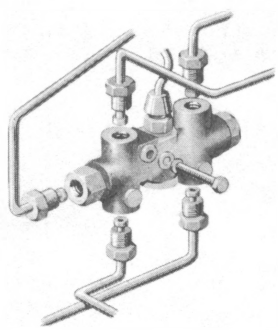


Fig. L:30 Differential valve installation

each piston assembly, seal end first, into the cylinder bore, taking great care not to damage the seals during insertion.

8. Fit the rubber boots on each end of the cylinder, and secure in position with the retainers.

9. Refit the brake shoes, and bleed the brakes, as described later in this section.

Replace

10. If the wheel cylinder must be replaced, disconnect the brake pipe(s) at the cylinder, and fit suitable blanking plugs to the pipe end (s), to prevent loss of fluid and the ingress of dirt.

11. Remove the two bolts securing the cylinder to the back plate, and remove the cylinder (Fig. L:19)

12. When installing the new wheel cylinder, ensure that the sealing ring is correctly located on the back of the cylinder.

13. Wipe the ends of the brake pipe(s) to remove any dirt, etc. Start the brake pipe union(s) in the threads of the cylinder connection(s) before installing the cylinder attaching bolts.

14. Once secured to the backplate, the pipe connection(s) can then be fully tightened. Otherwise the installation is a reversal of the removal procedure.

15. Finally, bleed the brakes, as described under the appropriate heading later in this section.

HANDBRAKE - Adjustment (Floor-Mounted)

1. Prior to adjustment, check that the cable follows its correct run, and is correctly located in the retaining clips. Operate the handbrake lever until the clicking sound of the adjuster mechanism ratchet at the rear brakes ceases (as applicable).

2. Place the handbrake lever in the "off" position. Check that the handbrake relay lever within the rear brake assemblies are in contact with the adjustment plungers.

3. This can be determined by checking that no perceptible movement of the plungers on the back plates can be felt (Fig. L:20)

4. Slacken the locknuts on the handbrake cable conduit at the R.H. abutment bracket.

5. Screw the nuts along the threaded sleeve to move the position of the sleeve relative to the bracket until all play in the handbrake cable is taken up (A clearance of 0.5 - 1.0 mm (0.020 - 0.040 in), measured at the adjustment plunger, should now exist between the relay lever and plunger, at each rear brake (Fig. L:21).

6. The cable can be moved by hand, from side to side, to even up the clearance if any bias is present due to friction in the system.

7. When the correct clearance is obtained at both rear brakes, tighten the cable locknuts. Check the handbrake lever operation. The brake effect at both rear wheels should be equal.

Dash-Mounted

8. Adjustment is effected in a similar manner as for the Floor-Mounted Control Lever, except that the front cable must first be adjusted as follows:

9. Slacken the locknuts at the front cable abutment bracket on the R.H. side of the car (Fig. L:25). Adjust the position of the nuts on the cable threaded sleeve; until a clearance of 0,5 - 1.0 mm (0.020 - 0.040 in) exists between the front cable relay lever and the "off-stop" on the support bracket (Fig. L:26).

10. When the correct clearance is obtained, tighten the locknuts at the cable abutment bracket.

11. Adjust the rear cable, as described above for the Floor-mounted Control Lever.

MASTER CYLINDER - Remove

1. Syphon the brake fluid from the master cylinder reservoir. On non-servo models, disconnect the master cylinder push rod from the brake pedal, by removing the spring clip, clevis pin, and clevis pin bushes.

2. Disconnect the brake pipes from the master cylinder outlets, by unscrewing the union nuts (Fig. L:29). Fit suitable blanking plugs in the pipe ends, to prevent the ingress of dirt.

NOTE: Brake fluid is corrosive, and will damage paintwork if allowed to come into contact with it.

3. Remove the two nuts and spring washers securing the master cylinder to the brake booster unit (bulkhead on non-servo models), and withdraw the master cylinder. Empty any remaining fluid into a waste container.

Refit

4. Install the master cylinder in the reverse order of removal. Fill the fluid reservoir with fresh hydraulic fluid, and bleed the brakes, as described later in this section.

5. When installation is completed, depress the brake pedal for about ten seconds, and then examine the master cylinder, to ensure that there are no signs of fluid leakage.

NOTE: When fitting a replacement master cylinder, prior to installation, lubricate the cylinder seals by injecting clean hydraulic fluid into the fluid outlets and behind the rubber boot, then operating the piston for several strokes.

Overhaul

NOTE: When overhauling the master cylinder an overhaul kit should be obtained, and all the parts fitted.

1. Remove the two screws securing the reservoir to the cylinder body, and detach the reservoir.

2. Remove and discard the sealing washer fitted in the primary recuperating valve entry port on the top of the cylinder body. Unscrew the valve retaining plug, using a suitable hexagon key, then lift out and discard the primary recuperating valve assembly.

3. Detach the rubber boot from the end of the cylinder, extract the circlip from the cylinder bore, and withdraw the push rod and guide washer.

4. Fit suitable plugs to the two fluid outlet ports. Block off the primary valve aperture.

5. Inject compressed air into the secondary recuperating valve aperature to expel the primary piston assembly, spring, and the secondary piston and secondary recuperating valve from the cylinder bore.

6. Remove the piston seal from the primary piston. Discard the seal.

7. Separate the secondary piston from its valve assembly, by carefully lifting the spring retainer tab which engages under the shoulder on the piston spigot.

8. Remove the piston seal from the secondary piston, and discard. Compress the spring on the secondary recuperating valve assembly, slide the valve stem to one side so that the stem is released from the "keyhole" in the spring retainer, and remove the spring retainer, spring, valve spacer and spring washer from the valve stem. Remove the rubber seal from the valve.

9. Clean and inspect the components, as described in "HYDRAULIC SYSTEM" and replace as necessary.

10. Fit a new seal to the secondary recuperating valve, with the flat face against the valve flange.

11. Slide the spring washer onto the valve stem, with the domed side towards the valve flange.

12. Locate the valve spacer against the washer, with the legs towards the valve seal. Fit the return spring over the valve stem, and insert the spring retainer into the end of the spring. Compress the spring and engage the end of the valve stem in the "keyhole" in the spring retainer.

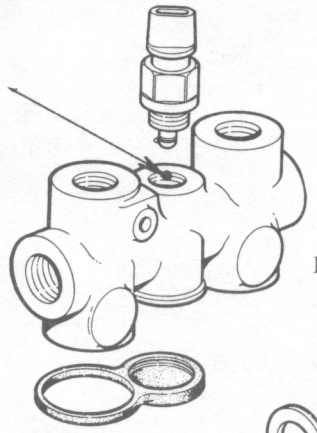
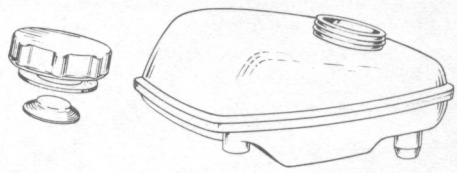


Fig. L:31 Exploded view of differential valve and switch assembly



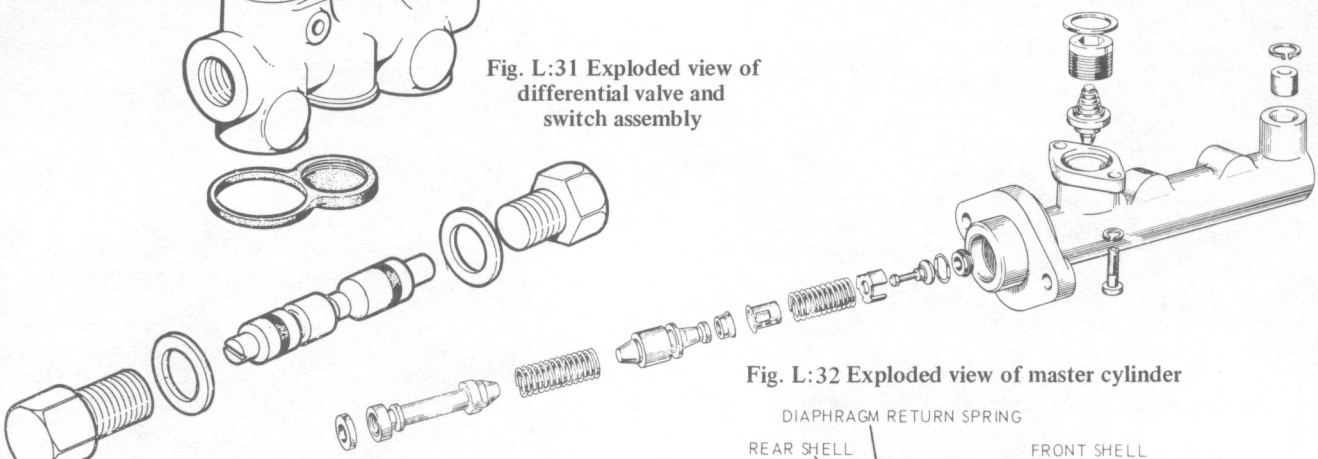
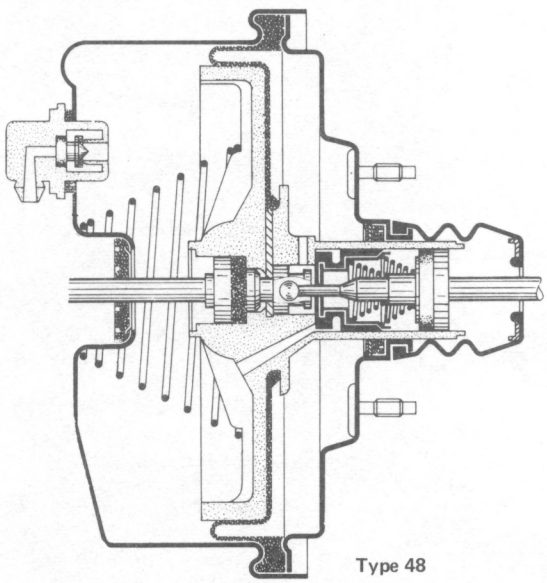
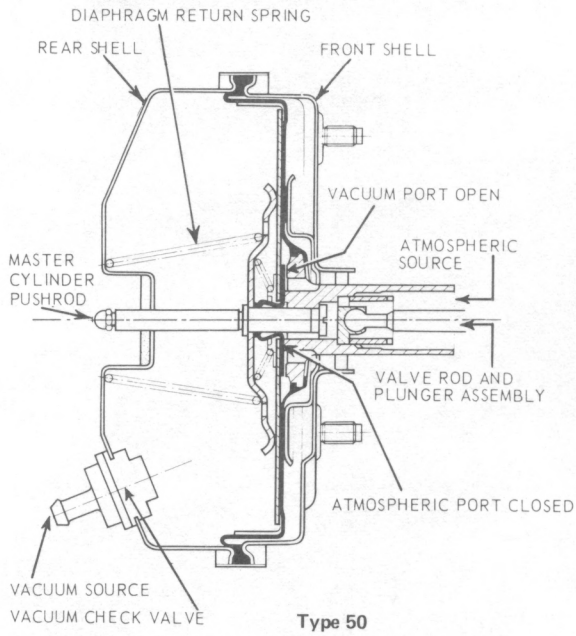


Fig. L:32 Exploded view of master cylinder



Type 48



Type 50

Fig. L:33 Sectional view of brake booster units

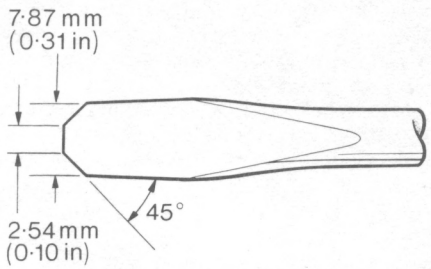


Fig. L:34 Differential valve centralising tool

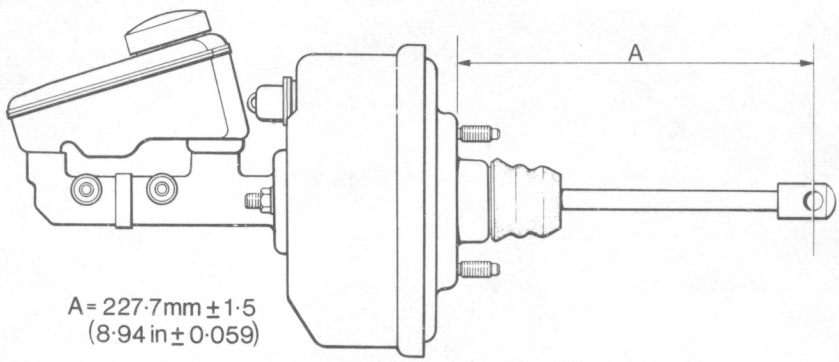


Fig. L:35 Booster unit push rod dimension

13. Fit a new seal to the secondary piston, with the flat face adjacent to the piston central shoulder (Fig. L:27).

14. Insert the piston spigot into the spring retainer on the secondary recuperating valve assembly, until the shoulder on the spigot engages the tab on the retainer. Press the tab down to secure the piston in position.

15. Lubricate piston assembly and master cylinder bore with clean brake fluid, then insert the piston assembly into the bore, valve end first (Fig. L:25). Care should be taken to avoid damaging the piston seal as it enters the cylinder.

16. Fit a new seal to the primary piston. Install the primary piston return spring in the cylinder bore. Lubricate the primary piston with clean brake fluid, and enter it into the cylinder, (drilled end leading).

17. Fit the push rod so that it engages the recess in the end of the piston, press the guide washer into position in the cylinder bore, and secure the complete assembly with the circlip.

18. Fit the rubber boot to the end of the cylinder. Check that the push rod moves freely.

19. Fit the primary recuperating valve into its aperature on the top of the cylinder body. Move the push rod, as necessary to gain access.

20. Screw the retaining plug into position, using a suitable hexagon key. Cycle the push rod, and check that the primary recuperating valve "tips" open when the push rod is fully withdrawn, and that the valve closes when the push rod is pushed in.

21. Fit a new rubber sealing washer in the recuperating valve entry port. Assemble the fluid reservoir to the cylinder body, and secure with the two crosshead screws.

PRESSURE DIFFERENTIAL VALVE AND SWITCH ASSEMBLY - Remove

1. Disconnect the wiring from the switch. Disconnect the brake pipes from the assembly (Fig. L:30). Fit suitable blanking plugs to the ends of the two pipes from the master cylinder.

2. Remove the securing bolt, and lift out the valve and switch assembly.

Refit

3. Fit the valve and switch assembly in position on the car, and loosely fit the securing bolt. Remove the blanking plugs, and reconnect the brake pipes.

4. Take care not to overtighten the union nuts. Fully tighten the securing bolt, and reconnect the wiring to the switch.

5. Bleed the braking system, as described later in this section.

Overhaul

6. Unscrew the switch from valve body. Unscrew the end plugs from both ends of the cylinder, and discard the gaskets.

7. If a fluid connection adaptor is fitted to one end of the cylinder in place of the end plug, note the end of the cylinder to which it was fitted, to ensure correct reassembly.

8. Push the two pistons out of the cylinder bore, taking extreme care to avoid damaging the bore surface finish.

9. Remove the seals from the pistons, and discard. Detach the dust cover from the underside of the cylinder, and discard.

10. Wash all parts in clean brake fluid. Do NOT use mineral base oils such as petrol, paraffin, or carbon tetrachloride. Use only new seals, gaskets and dust cover, on reassembly.

11. Fit the new seals to the pistons large diameter of each seal adjacent to the slotted end of the piston

12. Lubricate the pistons and cylinder bore with clean brake fluid. Insert the longer piston, slotted end outermost, until the groove is in line with the switch aperture.

13. Screw the switch into position so that the switch plunger engages in the groove in the piston. Insert the shorter piston into the cylinder, again slotted end outermost. Fit new copper gaskets to the end plugs (or end plug and adaptor), and screw them into the ends of the cylinder. If an adaptor was fitted to the cylinder, ensure that it is refitted to its original end. Tighten the switch, end plugs, and adaptor (if fitted) to their specified torques. Fit a new dust cover to the base of the assembly.

BRAKE SERVO UNIT

The brake booster unit is serviced only as an assembly, and therefore, if damaged or defective, the complete unit must be replaced.

Testing

1. With the engine stopped, the transmission in neutral, and the handbrake applied, depress the brake pedal several times to exhaust the vacuum in the system.

2. Depress the pedal, hold it in this position, and start the engine. If the booster unit is operating correctly, the pedal will tend to fall away under foot pressure, and less pressure will be required to hold the pedal in the applied position. If no difference is felt, the system is not functioning. Check all vacuum connections before replacing the unit.

Remove

3. Disconnect the push rod from the brake pedal, by removing the spring clip, clevis pin, and clevis pin bushes.

4. Remove the master cylinder from the booster unit, as described previously.

5. Disconnect the vacuum supply hose at the booster unit. Remove the nuts securing the booster unit mounting bracket to the bulkhead, and withdraw the unit complete with its mounting bracket.

6. Remove the nuts securing the booster unit to the mounting bracket, and detach the booster.

Refit

7. Assemble the booster unit to the mounting bracket. Check the push rod length, by measuring the distance between the front face of the bracket and the centre-line of the hole in the push rod clevis yoke (Fig. L:35). This should be:-

Type 38 unit 222.7 mm±1.5 mm (8.94 in±0.060 in)
Type 50 unit 293.4 mm±1.5 mm (11.55 in±0.060 in)

8. Install the booster unit on the car in the reverse order of removal. Refit the master cylinder, as described previously, then bleed the braking system.

BRAKING SYSTEM - Bleeding

1. The piston in the pressure differential valve and switch assembly must be held in the central position during the complete bleeding operation, otherwise it will be difficult to get the brake warning light to go out and stay out.

2. A special tool is required for this operation, and can be made up from a screwdriver with the blade modified to the dimensions given in Fig. L:34. Remove the rubber dust cover from the base of the valve assembly and insert the tool through the aperture in the base.

3. The fluid level in both halves of the master cylinder reservoir should be topped up, as required, during the bleeding operation. It must NOT be allowed to drop excessively, otherwise air may be drawn into the system. Use only fresh hydraulic fluid of the specified type (see TECHNICAL DATA). Never reuse fluid which has been drained from the system.

4. Remove the rubber dust cap from the bleed valve on the R.H. front brake caliper. Attach one end of a bleed tube to the bleed valve and immerse the other end in a small quantity of hydraulic fluid in a glass jar.

5. Open the bleed valve about half-a-turn, depress the brake pedal through its full travel, and then allow it to return to the fully released position.

6. Hydraulic fluid should have been pumped into the jar. If not, continue to pump the pedal until the fluid coming from the bleed tube is completely free from air bubbles.

7. Finally with the brake pedal in the fully depressed position, close the bleed valve. Take care not to over-tighten the valve. Remove the bleed tube, and refit the rubber dust cap.

8. Repeat the complete process for the other front brake, and then the rear brakes. Top-up the fluid reservoir to the level indicated on the side, then refit the filler cap, after checking that the vent hole is free.

9. Remove the centralising tool from the differential valve and refit the rubber dust cover on the base of the valve.

10. Check the operation of the valve, by depressing the brake pedal several times with the ignition switched on. The brake warning light should not illuminate.

11. With the ignition still switched on operate the test switch. The warning light should illuminate.

Technical Data

FRONT BRAKES

Type	Disc, trailing caliper
Caliper type 2000 Estate	Girling M16F
All other models	Girling M16
Minimum pad thickness	3,18 mm (0.125 in)
Pad swept area	1,255 sq.cm (192 sq.in)
Disc dia.	247,5 mm (9.74 in)
Disc thickness	12,7 mm (0.5 in)
Max. disc run-out	0,05 mm (0.002 in)
Cylinder dia.	54,0 mm (2.13 in)

REAR BRAKES

Type	Drum, leading and trailing shoe
Size	
1300/1600 Saloon and Family Estate	203,2 x 38.1 mm (8 x 1.5 in)
1300/1600 Business Estate, 1600 GT and 2000	228,6 x 44.5 mm (9 x 1.75 in)
Lining material	M79
Minimum lining thickness	1,52 mm (0.06 in)
Wheel cylinder dia.	
1300/1600 Saloon and Family Estate	20,64 mm (0.813 in)
1300/1600 Business Estate and 2000 Family and Business Estate	19,05 mm (0.75 in)
1600 GT and 2000 Saloon	17,78 mm (0.70 in)

MASTER CYLINDER

Cylinder dia.	
1300/1600 Saloon and Family Estate without Brake Servo	19,05 mm (0.75 in)
All other models	20,64 mm (0.813 in)

BRAKE SERVO

Type	Girling type 38
Ratio	2.2:1
Application	Optional
1300/1600 Saloon and Family Estate	Optional
All other models	Standard

HYDRAULIC FLUID

Type	ESEA - M6C - 1001A

Electrical Equipment

GENERAL
CHARGING SYSTEM PRECAUTIONS
GENERATOR CHARGING SYSTEM
GENERATOR
ALTERNATOR CHARGING SYSTEM (LUCAS)
ALTERNATOR CHARGING SYSTEM (BOSCH)
LUCAS ALTERNATOR
BOSCH ALTERNATOR
LUCAS INERTIA STARTER
PRE-ENGAGED STARTER (LUCAS M 3.5 G)
PRE-ENGAGED STARTER (LUCAS M 3.5 J)
PRE-ENGAGED STARTER (LUCAS M 100)
BOSCH STARTER
TECHNICAL DATA

GENERAL

The 12 volt electrical system has negative ground polarity. The charging system on all, except 1300 models, includes an alternator which may be of either Lucas or Bosch manufacture. In general, the Lucas alternator is used on 1600 & 1600 GT models, and the Bosch on 2000 models. The Lucas alternator has an integral voltage regulator. The Bosch unit, regulator is remotely mounted.

Several types of starter motor are used, dependent on model application. Refer to TECHNICAL DATA at the end of the section for identification and application. On the positive pre-engaged type starter motors, the drive pinion is moved into the engaged position by an integral solenoid before beginning to rotate. The Lucas types M 3.5 J and M 100 starter motor employ a face-contact commutator in which the brushes bear on the end face of the commutator, as opposed to the periphery on conventional starters.

CHARGING SYSTEM PRECAUTIONS

It is essential that the following points be observed when carrying out any maintenance or repairs on a charging system which incorporates an alternator.

1. Never remove the alternator or regulator unit without first disconnecting the battery earth lead.
2. Never disconnect or reconnect the battery leads while the alternator is running, otherwise damage may occur to the rectifier and/or regulator unit semi-conductor devices. It is inadvisable to break or make any other connection in the charging circuit while the engine is running.
3. Never run the alternator with the main output cable disconnected either at the alternator or the battery while the field windings remain energised, otherwise the rectified diodes may be damaged.
4. When reconnecting the battery leads, always ensure that the correct polarity is observed. Reversal of the battery connections will damage the rectifier diodes. Connect positive lead to positive terminal first, then connect negative lead to negative terminal.
5. Never allow the alternator main output lead to earth if it is disconnected at the alternator as, even when the engine is not running, this lead is "live". If the lead is earthed, damage to the cable will occur.
6. Always disconnect the battery earth leads before using a battery charger, as this will isolate the alternator from the battery and external charging equipment. Connect positive to positive, and negative to negative.
7. If arc welding is to be carried out on the vehicle, isolate the alternator and regulator unit by disconnecting the wiring connectors and the battery earth lead.
8. Never use an ohmmeter of the type incorporating a hand-hand-driven generator for checking the rectifier or transistors.

GENERATOR SYSTEM - Testing

Battery

1. Test the specific gravity (SG) of the battery electrolyte with a hydrometer. Draw enough electrolyte into the hydrometer to make the scale float. If the level is so low that a reading cannot be taken, add distilled water and charge the battery for at least one hour before checking the S.G.
2. If the S.G. reading is below 1.230, the battery should be placed on charge.

NOTE: If the difference in S.G. readings between any two cells is more than 0.05 the battery is not satisfactory.

Leads and Connections

3. Inspect the complete charging circuit for faulty wiring or insulation and loose or corroded connections, particularly the earth connections. Correct any faults before proceeding with the tests.

Drive Belt

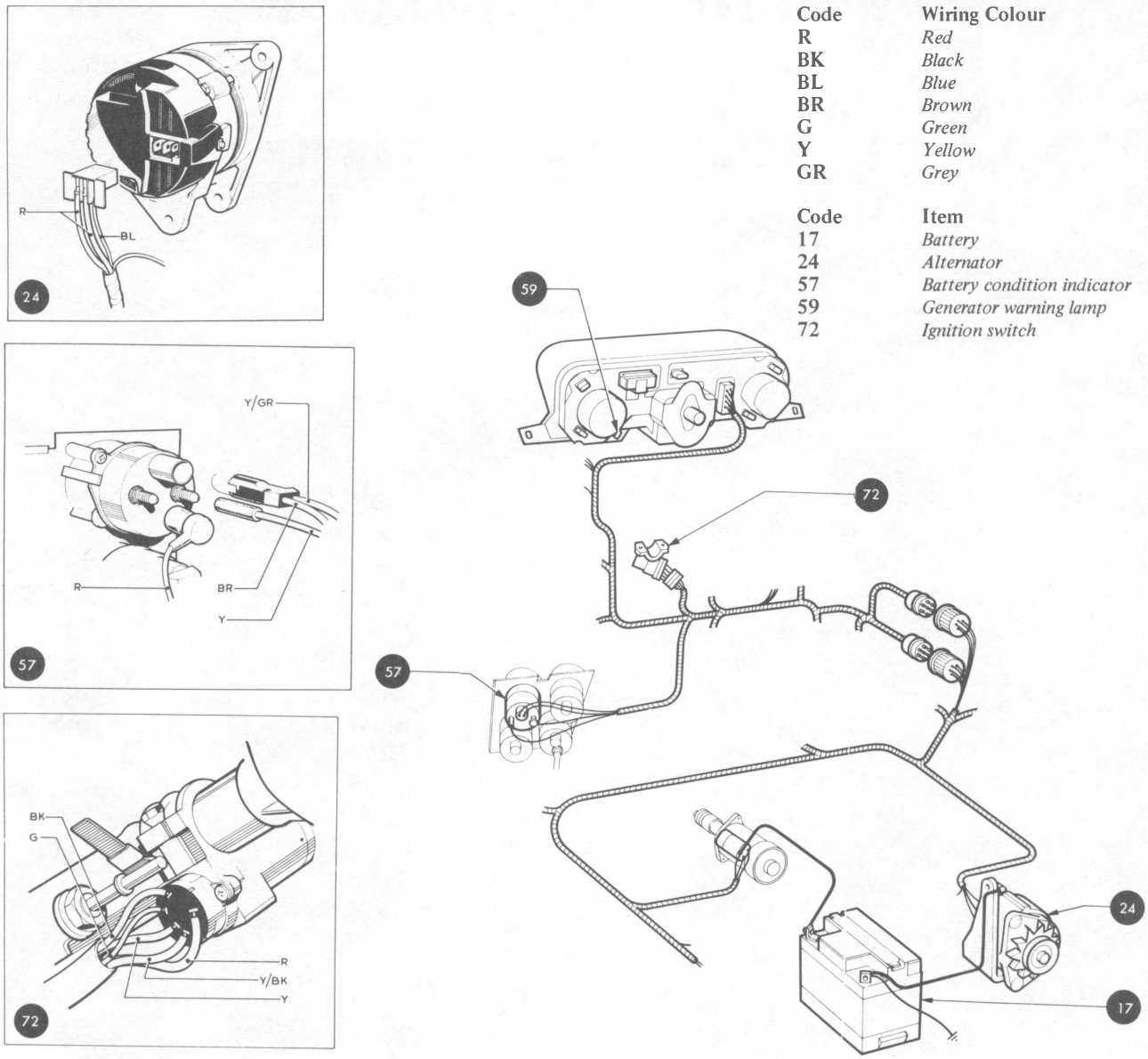
4. Check the condition and tension of the drive belt, as described in the COOLING SYSTEM section. Replace the belt or adjust the tension, as necessary.

Generator Output

5. Disconnect the leads from the 'D' and 'F' terminals on the regulator, and join the leads together. Connect a 0 - 30 moving coil type voltmeter between their junction and earth.
6. Run the engine at approx. 1,000 rev/min, and note the voltmeter reading. The reading should rise rapidly without fluctuation to above 24 volts.

NOTE: Do not exceed this speed in an attempt to obtain this voltage, otherwise the generator may be damaged.

7. If an incorrect reading is obtained, disconnect the leads from the 'D' and 'F' terminals on the generator, and connect a short jump lead between the generator terminals.
8. Connect the voltmeter between one of the terminals and earth, as shown in Fig. M:2, and repeat the test.
9. If the reading is now satisfactory, the fault must lie in the 'D' and 'F' leads between the generator and regulator, and these should be checked for breaks or damage.
10. If an incorrect reading is still obtained and a radio suppression capacitor is fitted between the generator output terminal and earth, disconnect the capacitor, and repeat the test. If the reading is now satisfactory, the capacitor is defective, and must be replaced.
11. If no reading is obtained, check the generator brushes, brush connections, and generator internal leads.



Code	Wiring Colour
R	*Red*
BK	*Black*
BL	*Blue*
BR	*Brown*
G	*Green*
Y	*Yellow*
GR	*Grey*

Code	Item
17	*Battery*
24	*Alternator*
57	*Battery condition indicator*
59	*Generator warning lamp*
72	*Ignition switch*

Fig. M:1 Charging system components and connections - (L.H.D. shown)

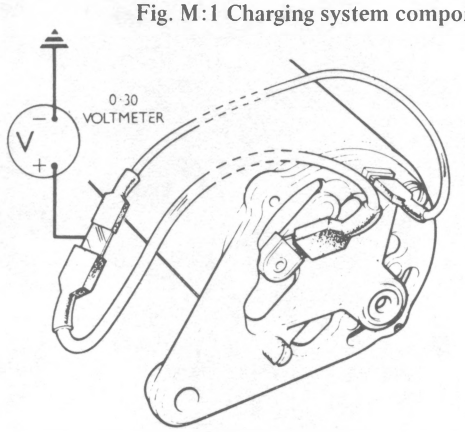


Fig. M:2 Generator output test connection

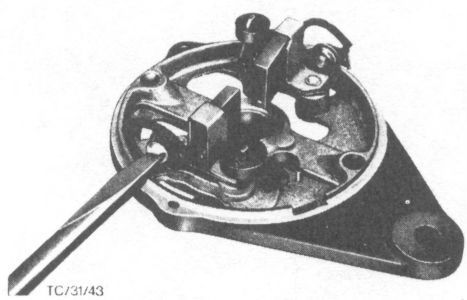


Fig. M: 3 Replacing generator brushes

12. If the reading is very low, the field or armature windings may be suspect. A reading of between 0.5 - 1.0 volts indicates a fault in the field windings as a possible cause, whilst a reading of 4 - 5 volts indicates a fault in the armature windings.

13. If the reading is incorrect, but does not indicate the cause of the trouble, proceed with the tests below.

Motoring Test

14. Remove the generator drive belt. Disconnect the voltmeter fitted for the output test. Connect a 0 - 30 ammeter between one of the generator terminals and the non-earth terminal on the battery. The generator should now motor and a reading of 4 - 6 amps, should be indicated on the ammeter.

15. If the reading is high, this is an indication of tight generator bearings. If the reading is excessively high, this indicates a short circuit. If the reading is low, this is a general indication of bad commutation.

GENERATOR - Remove/Refit

1. Disconnect the battery earth lead. Disconnect the leads from the 'D' and 'F' terminals on the rear of the generator.

2. Slacken the two generator mountings bolts and self-locking nuts, and the adjusting bolt. Push generator towards the engine to relieve the drive belt tension, and remove the drive belt. Fully remove the adjusting and mounting bolts, and lift out the generator.

3. Install the generator in the reverse order of removal. Adjust the drive belt tension so that a total free-movement of 13 mm. (0.5 in) exists at a point midway between the generator and water pump pulleys.

4. When reconnecting the generator leads, ensure the larger connector is fitted to the 'D' terminal and the smaller connector to the 'F' terminal on the generator.

Brush Gear

5. Unscrew and remove the two through-bolts at the rear of the generator, and withdraw the commutator end bracket from the generator frame. Lift up the brush springs and withdraw the brushes from their holders.

6. Inspect the brushes for wear. Brushes which are approaching, the minimum length of 8 mm (0.32 in) must be renewed as a set.

7. Check the commutator contact surface for oil contamination. If present, the brushes must be renewed.

8. If the commutator is blackened or dirty, clean it with a petrol-moistened cloth and dry carefully. The contact surface of the commutator should be smooth and dark grey in colour.

If there is evidence of burning, this can be cleaned off with very fine glass paper. On no account must emery cloth, or similar abrasive, be used. If the commutator is badly worn, burned or pitted, it must be skimmed or replaced.

10. To renew the brushes, remove the screw and lock washer securing each brush lead to its holder, and detach the brushes (Fig. M:3). Ensure that the replacement brushes are of the correct type and length. Secure the leads of the new brushes to their respective holders.

11. Check the brushes for freedom of movement in their holders. Sticking brushes can usually be freed by cleaning the brushes and holders with a petrol-moistened cloth, or if necessary by lightly polishing the brush sides on a smooth file.

12. Check the brush spring pressures, using a pull-type spring scale. Hook the spring scale on the end of the brush spring and measure the pull required to lift the spring clear of its brush. If the tension is less than 453 grammes (16 oz), fit new springs the tension for new springs should be 935 grammes (33 oz).

13. To reassemble the brush gear, locate the brush springs on the side of each brush to hold them in the raised position. Check that fibre thrust washers are fitted on the commutator end of the armature shaft, and refit the commutator end bracket. Ensure that the dowel in the end of the bracket engages the notch in the generator frame.

14. Fit the through-bolts and tighten securely. Insert a thin-screw driver through the ventilation hole in the commutator end bracket adjacent to the brush holders, and gently lever up the spring end. Press the brush down onto the commutator, and position the spring end on the top of the brush. Repeat for the other brush.

Dismantling

15. Slacken the pulley securing nut. Remove the nut and lock washer, and draw the drive pulley off the armature shaft. Take care not to damage the plastic pulley, if this type is fitted. Remove the Woodruff key from the shaft and slide off the spacer.

16. Unscrew and remove the two through-bolts at the rear of the generator, and withdraw the commutator end bracket from the generator frame. Remove the fibre thrust washers from the rear end of the armature shaft, and retain.

17. Withdraw the armature, complete with the drive end bracket, from the generator frame.

18. Draw the drive end bracket off the armature shaft, using a suitable puller.

19. Clean the frame, field coils, armature and end brackets, with a brush or air line. Wash all other parts in solvent, and dry thoroughly.

Inspection

Field Coils

1. Check the field coils visually for burned for broken insulation, and for broken or loose connections.

Armature

2. Clean and inspect the commutator, as described in 'Brush Gear'. If the commutator requires skimming, this operation should be entrusted to an Electrical Specialist.

3. Indications of a short circuit between the commutator segments or in the armature windings, are shown by discolouration of any one or two coils, and a blackening or two or more commutator segments. An open circuit will cause burned spots between the commutator segments.

Bearings

4. The armature shaft bearings are carried in the end brackets, and consist of a porous bronze bush at the commutator end. If worn or damaged, the bearings can be replaced as follows:

Commutator End

5. Remove the old bush from the commutator end bracket by screwing a suitable size of tap a few turns squarely into the bush, then withdrawing the tap and bush.

6. Remove the felt ring and retainer, and clean the housing. Renew the felt washer if necessary.

7. Install the felt ring and retainer in the bore, and press in the new bush until it is flush with the end of the bore. The bush must be soaked in engine oil for 24 hours prior to fitting.

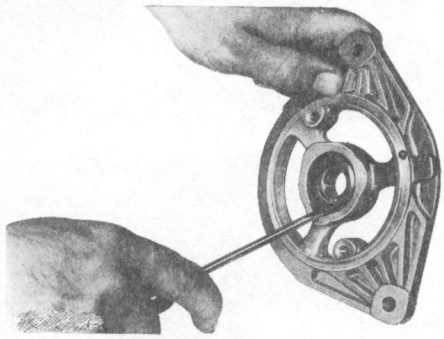


Fig. M:4 Extracting drive bearing circlip

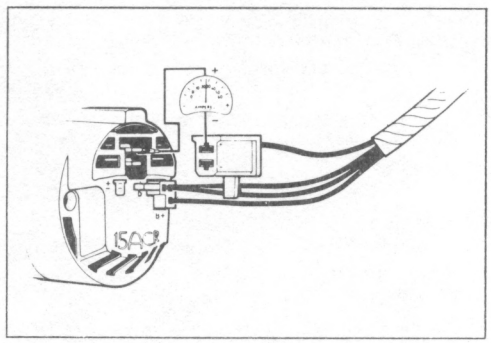


Fig. M:5 Alternator output test - Lucas

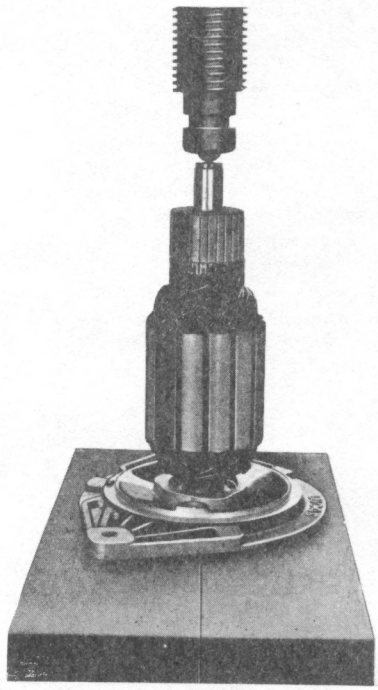
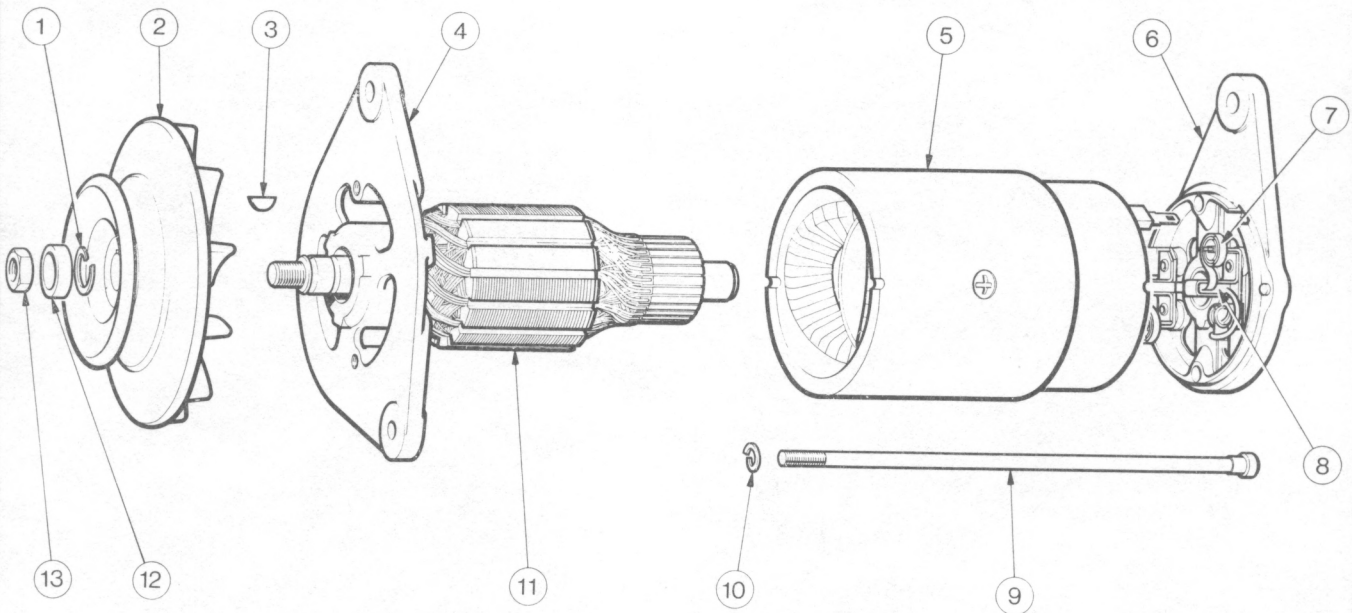


Fig. M:6 Installing drive end bracket on armature



1. *Spring*
2. *Cooling fan*
3. *Woodruff key*
4. *Drive end bracket*
5. *Generator frame*
6. *Commutator end bracket*
7. *Brush spring*
8. *Carbon brush*
9. *Through-bolt*
10. *Spring washer*
11. *Armature*
12. *Bearing*
13. *Nut*

Fig. M:7 Exploded view of generator

Drive End

8. Remove the circlip securing the bearing retainer plate in the drive end bracket, and extract the bearing from the bracket (Fig. M:4).

9. Remove the pressure ring, felt ring retainer plate, and felt ring from the bracket bore. Clean all items.

10. Install the components in the reverse order of removal. Pack the bearing with high melting point grease before installing.

Reassembly

11. Support the drive end bracket, and press the armature shaft into the end bracket bearing (Fig. M:6).

12. Assemble the armature and drive end bracket to the generator frame, ensuring that the locating dowel on the bracket correctly engages the groove in the frame.

13. Fit the two thrust washers on the rear end of the armature shaft and refit the commutator end bracket, as described previously in 'Brush Gear'. Fit the spacer on the front end of the armature shaft and engage the Woodruff key in its locating groove.

14. Fit the drive pulley and secure with the nut and lock washer. Tighten the nut to its specified torque.

ALTERNATOR CHARGING SYSTEM (LUCAS)

Testing

Proceed as for Items 1 - 3 GENERATOR SYSTEM - Testing.

Voltage Drop Test

1. A first-grade moving coil type voltmeter with a low-range scale suitable for readings of 0.25 volts is required for these tests. Connect a voltmeter between the positive (+) terminal of the battery and the positive (+) terminal of the alternator.

2. Switch the headlights on main beam. Start the engine, run at approx. 3,000 rev/min and note the voltmeter reading.

3. If the reading exceeds 0.5 volts, a high resistance in the positive side of the charging system is indicated.

4. Repeat the test with the voltmeter connected between the negative (–) terminal of the battery and the negative (-) terminal of the alternator. If the voltmeter reading exceeds 0.25 volts, a high resistance in the negative side of the charging system is indicated.

5. If a high resistance is indicated, check loose, dirty or corroded connectors, they should be clean and tight.

Cable Continuity

6. Connect the negative (black) lead of a 0 - 30 voltmeter to earth, and with the ignition switched on, connect the positive (red) lead to each of the cable connectors in turn. In each case, battery voltage should be indicated. If battery voltage is not available at the connectors, a fault exists in the cable and should be located and remedied.

Alternator Output

NOTE: Do not make any connections to the inner (negative) main terminal.

7. Switch on the headlights and leave for five minutes. Ensure that the ignition is switched off, then disconnect the main output cable connector from the alternator positive (+) terminal. Connect the positive (red) lead of a 0 - 60 ammeter to the alternator positive (+) terminal, and the negative (black) lead to the main output cable (Fig. M:5).

8. Start the engine, run at charging speed, and note the ammeter reading. This should be approximately equal to the alternator rated output (i.e. 28 amps for 15 ACR; 36 amps for 17 ACR). If the rated output cannot be obtained, the alternator should be removed from the car for further inspection or repair.

Regulator Control Voltage

9. With the ammeter connected as above, also connect a voltmeter across the battery terminals as shown in Fig. M:8.

10. Start the engine and run until the charging rate falls below 10 amps. The voltmeter should then read 14.1 - 14.4 volts If this reading cannot be obtained, the alternator should be removed from the car for further inspection or repair.

ALTERNATOR CHARGING SYSTEM (BOSCH)

Testing

Proceed as for Items 1 - 3 in 'GENERATOR CHARGING SYSTEM - Testing'.

Regulator Control Voltage

1. Connect a voltmeter and an ammeter with load resistor between the alternator 'B+' terminal and earth, as shown in Fig. M:9. Start the engine, bring to 2,000 - 2,200 rev/min and, with the resistor, apply the rated output (i.e. 28 amps. - 28 G1; 35-amps - 35A-K1) to the alternator.

2. Adjust the engine speed and load as quickly as possible to prevent overheating the regulator.

3. Reduce the engine speed, then immediately increase again to 2,000 - 2,200 rev/min and note the voltmeter reading. A regulating voltage of 14.1 - 14.6 volts should be indicated. The reading must be taken during a period not exceeding 30 seconds.

4. Repeat the test at the same speed but with a load of 3 - 5 amps. The regulating voltage should now be 13.7 - 14.4 volts

5. When the test is completed, switch off the engine, and remove the test instruments.

Alternator Rated Voltage

6. Connect a voltmeter between the alternator 'B+' terminal and earth, as shown in Fig. M:10. Start the engine, and note the voltage reading at approx. 500 rev/min. The voltmeter must indicate a voltage of 14 volts Do not exceed an engine speed of 600 rev/min during this test. Switch off the engine, and disconnect the voltmeter.

Alternator Output

7. Connect a voltmeter between the alternator 'B+ terminal and earth. Connect an ammeter between the alternator 'B+' terminal and the 'B+' cable.

8. Connect a load resistor across the battery terminals, as shown in Fig. M:11. Connect a tachometer to the engine.

9. Start the engine, bring to approx. 1,100 rev/min, and apply a load with the resistor. The ammeter should then indicate a charging current of 2/3rds the rated output.

10. Increase the engine speed to approx. 3,000 rev/min and again apply a load. The charging current reading should be at the rated output (i.e. 28 amps - 28 G1,35 amps - 35A-K1).

11. To test the alternator output without the regulator stop the engine and disconnect the load resistor from the battery terminals.

12. Pull the multi-point connector from the regulator unit and connect a jump lead between the 'DF' terminal in the connector and the battery positive terminals (Fig. M:12).

13. Start the engine and briefly increase the speed. The

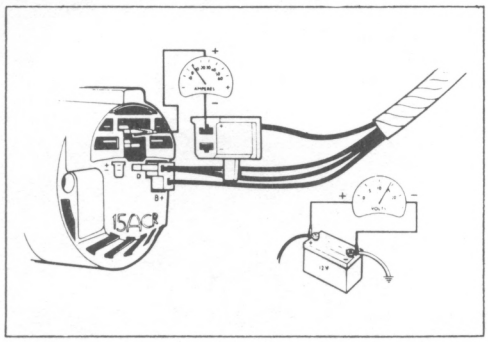


Fig. M:8 Regulator control voltage test - Lucas

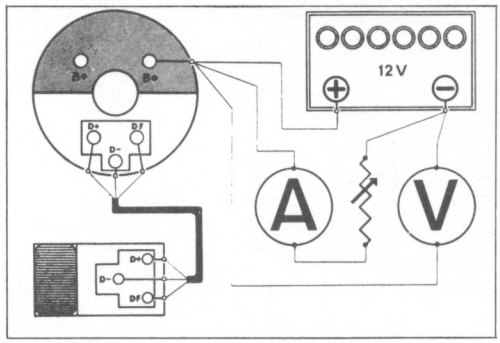


Fig. M:9 Regulator control voltage test - Bosch

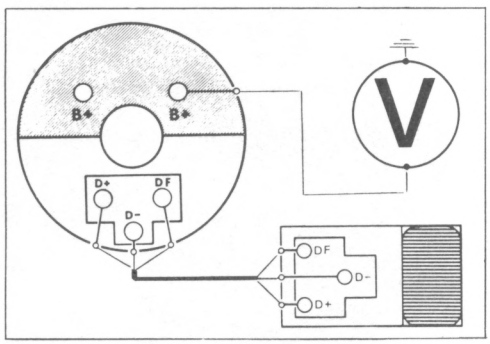


Fig. M:10 Rated voltage test - Bosch

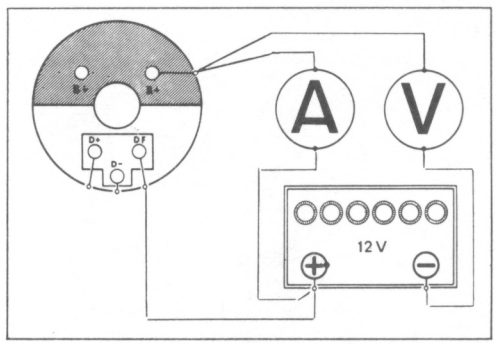


Fig. M:11 Alternator output test - Bosch

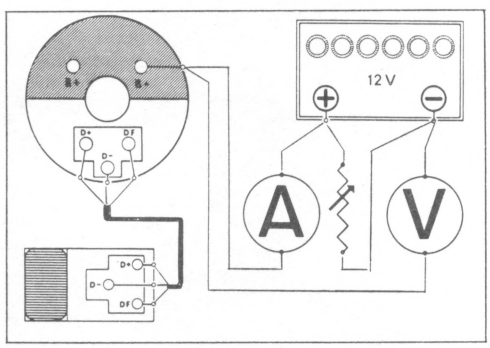


Fig. M:12 Output test without regulator - Bosch

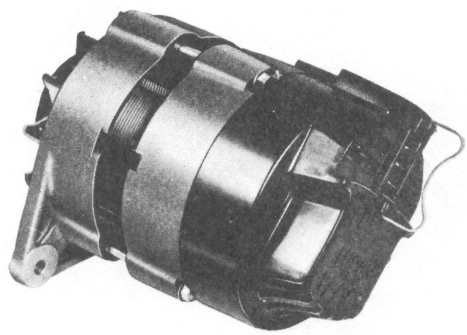


Fig. M:13 Lucas 17 ACR alternator
(15 ACR similar)

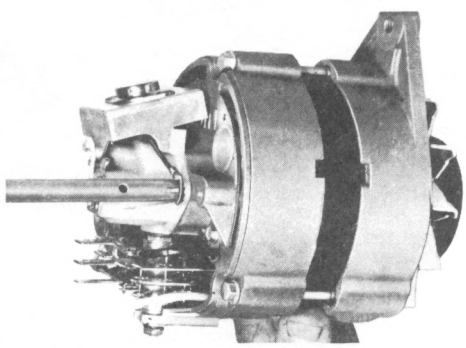


Fig. M:14 Removing brush gear and
regulator assembly - Lucas

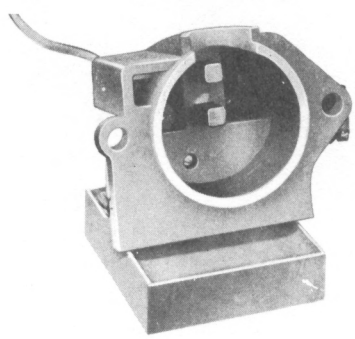
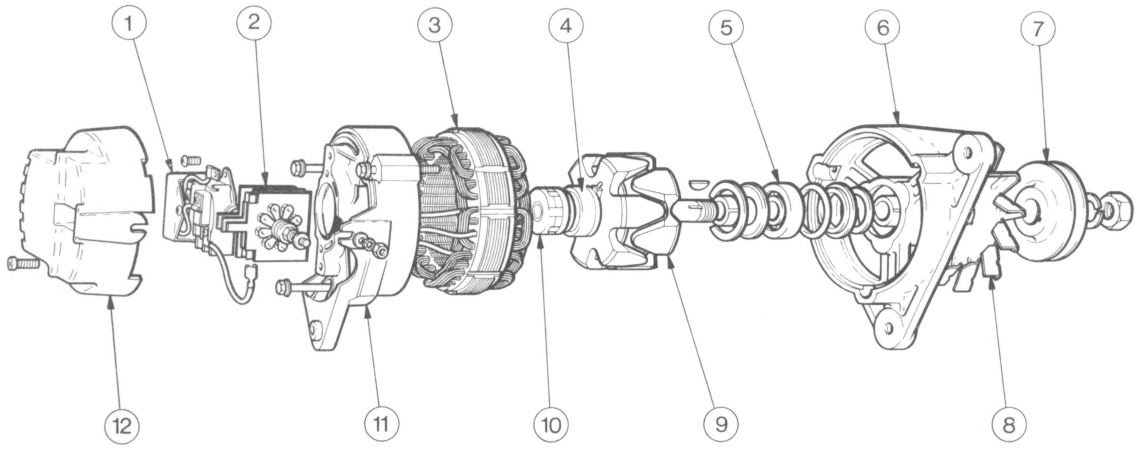
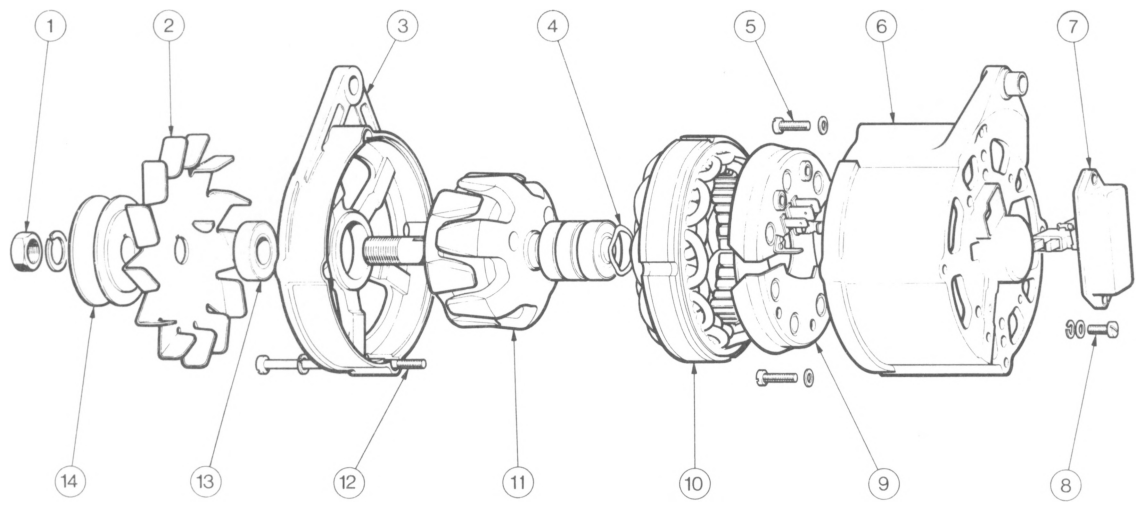


Fig. M:15 Brush moulding - Lucas



1. *Brush gear and regulator assembly*
2. *Rectifier pack*
3. *Stator*
4. *Slip ring end bearing*
5. *Drive end bearing*
6. *Drive end bracket*
7. *Drive pulley*
8. *Cooling fan*
9. *Rotor*
10. *Slip ring*
11. *Slip ring-end bracket*
12. *Plastic cover*

Fig. M:16 Exploded view of Lucas alternator



1. *Nut*
2. *Cooling fan*
3. *Drive end bracket*
4. *Valve washer*
5. *Rectifier pack retaining screws*
6. *Slip ring end bracket*
7. *Brush box*
8. *Brush box retaining screws*
9. *Rectifier pack*
10. *Stator*
11. *Rotor*
12. *Through-bolts*
13. *Drive end bearing*
14. *Drive pulley*

Fig. M:17 Exploded view of Bosch alternator

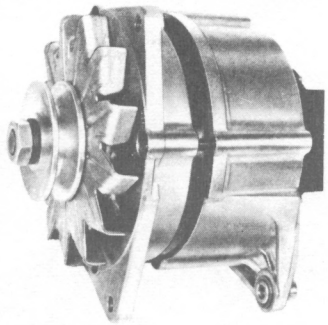


Fig. M:18 Bosch alternator

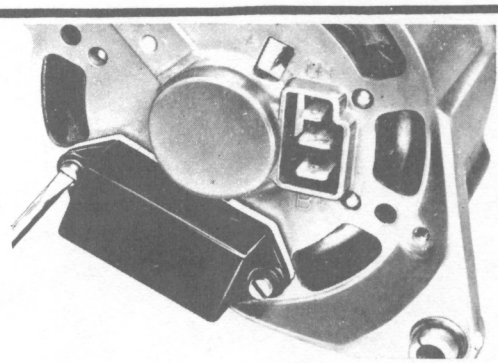


Fig. M:19 Removing brush gear - Bosch

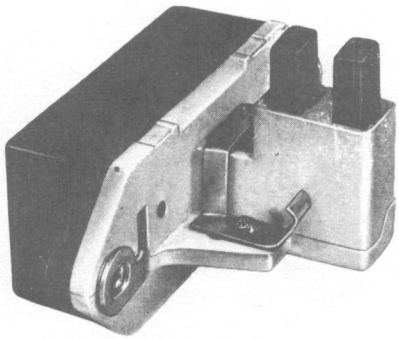


Fig. M:20 Brush holder - Bosch

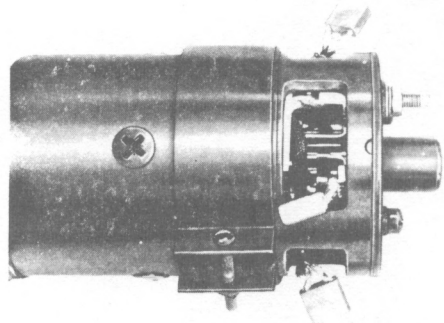
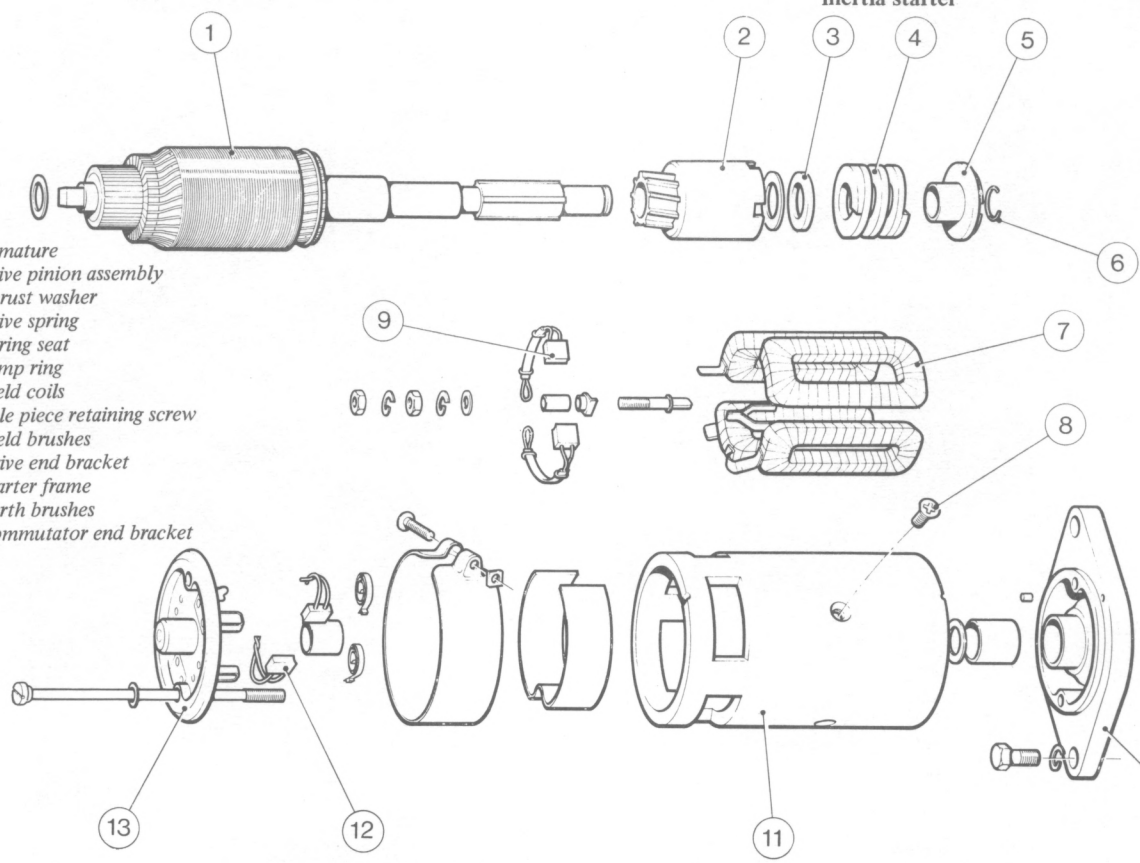


Fig. M:21 Brushes removed from holders - inertia starter



1. *Armature*
2. *Drive pinion assembly*
3. *Thrust washer*
4. *Drive spring*
5. *Spring seat*
6. *Jump ring*
7. *Field coils*
8. *Pole piece retaining screw*
9. *Field brushes*
10. *Drive end bracket*
11. *Starter frame*
12. *Earth brushes*
13. *Commutator end bracket*

Fig. M:22 Exploded view of Lucas inertia starter

ammeter and voltmeter should now indicate the rated output +/- 4 amps and 14-16 volts respectively. This test must be carried out as quickly as possible, otherwise damage to the alternator field coils may occur.

LUCAS ALTERNATOR - Remove/Refit

1. Disconnect the battery earth lead. Disconnect the wiring connectors from the rear of the alternator. Slacken the alternator mounting bolts. Remove the bolt securing the alternator to the adjustment arm, move the alternator towards the engine, and detach the drive belt. Remove the alternator mounting bolt and lift out the alternator.
2. Refit the alternator in the reverse order of removal. Adjust the drive belt tension so that a total free-movement of 13 mm. (0.5 in) exists at a point midway between the alternator and water pump pulleys.

Brush Gear

3. Remove the two retaining screws and detach the black plastic cover from the rear of the alternator. Disconnect the yellow lead (and, if fitted, the black lead) from the terminals on the rectifier pack.
4. Remove the two bolts securing the brush gear moulding and withdraw the moulding complete with the regulator (Fig. M:14).
5. If required, the regulator can be separated from the brush box, by removing the screw securing the regulator to the box face, and the two screws securing the regulator green and yellow leads to the brush moulding connectors.
6. With the brushes in the free position, measure the amount by which the brushes protrude beyond the brush box moulding. The brush length when new is 13 mm (0.5 in). If the amount protruding is worn to 5 mm (0.2 in) or less, the brush assemblies should be renewed.
7. Check the brushes for freedom of movement in their holders.

NOTE: Clean a seized brush with a petrol-moistened cloth or, if necessary, by lightly polishing the brush sides on a smooth file.

8. Check the brush spring pressure using a push type spring gauge. With the brush pushed into its holder against the spring tension until the brush face is flush with the housing, a reading of 198 - 293 gr (7 - 10 oz) should be obtained.
9. Replace a brush assembly which gives a reading outside these limits, where this is not due to the brush being seized.
10. Inspect the surface of the slip rings on the end of the rotor. The surface should be smooth, and uncontaminated by oil or other matter.
11. Clean the surfaces with a petrol-moistened cloth. If there is evidence of burning, this can be cleaned off with very fine glass paper. On no account must emery cloth or similiar abrasive be used.
12. Clean off any dirt or oil which may have collected around the apertures in the plastic end cover and the slip ring end bracket.
13. If removed, refit the regulator to the brush box and reconnect the green and yellow leads to the brush moulding connectors.
14. Check that the brushes are correctly positioned in their holders, then refit the brush moulding. Attach the brush moulding to the end bracket with the two securing bolts.
15. Reconnect the yellow lead (and black lead, if fitted) to the rectifier pack. Refit the plastic end cover and secure with the two retaining screws.

BOSCH ALTERNATOR - Remove/Refit

The remove and installation procedure is similar to that described for the LUCAS alternator.

Brush Gear

1. Remove the two screws securing the brush holder to the rear of the alternator, and withdraw the brush gear assembly (Fig. M:19).
2. Inspect the brushes for wear. The brush length when new is 14.0 mm (0.56 in.). If worn to 9.0 mm (0.35 in) or less, the brush assemblies should be renewed. If the brushes are satisfactory inspect the brush leads and springs for breakage.
3. To renew the brushes, grip the brush lead with flat-jawed pliers, and unsolder it from its connection. Insert the new brushes and resolder (take care that no solder enters the stranded wire).
4. Check the brushes for freedom of movement in their holders.

NOTE: Clean a seized brush with a petrol moistened cloth or, if necessary, by lightly polishing the brush sides on a smooth file.

5. Check the brush spring pressure, using a push-type spring gauge. A reading of 300-400 gr (10.6 - 14.1 oz) should be obtained. Renew springs which give a reading appreciably outside these limits, where this is not due to the brush being seized.
6. Check that the brushes are correctly positioned in their holders, and refit the brush holder to the slip ring end bracket. Fit and tighten the securing screws.

LUCAS INERTIA STARTER - Remove/Refit

1. Disconnect the battery leads. Disconnect the starter motor main cable at the starter solenoid.
2. Remove the starter motor upper mounting bolt. Raise the front of the car to gain access, and remove the starter motor lower mounting bolts. Withdraw the starter motor front from beneath the car.
3. Install the starter motor in the reverse order of removal. Ensure that all terminals are clean, and the cable connections are securely tightened. When installation is complete, check the operation of the starter motor.

Brush Gear

4. Slacken the clamp screw, and slide the brush cover away from the brush apertures. Lift the brush springs, using a piece of hooked wire, and withdraw the brushes from their holders. If the original brushes are to be re-used, they must be refitted in their original positions.
5. Inspect the brushes for wear. If a brush is damaged or if the flexible lead is visible on the brush contact face, the brushes must be renewed as a set.
6. If the brushes are to be renewed, remove the nuts, washers and insulation bush, from the field terminal post.
7. Unscrew the two through-bolts and withdraw the commutator end plate from the starter yoke.
8. Check the commutator for oil contamination. If present, the brushes must be renewed. If the commutator is blackened or dirty, clean with a petrol-moistened cloth, and dry thoroughly afterwards, or clean with very fine glass paper. NEVER use emery cloth for this purpose, and NEVER attempt to undercut the mica insulation between the commutator segments.
9. To renew the earthed brushes on the commutator end plate, unsweat the brush leads from the terminal eyelet adjacent to the brush box (Fig. M:23).

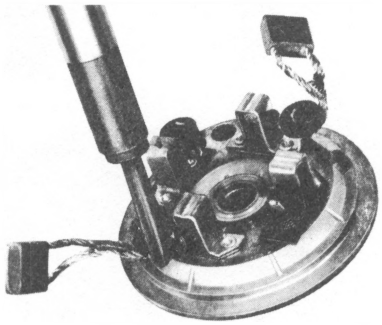


Fig. M:23 Unsoldering earth brush leads - inertia starter

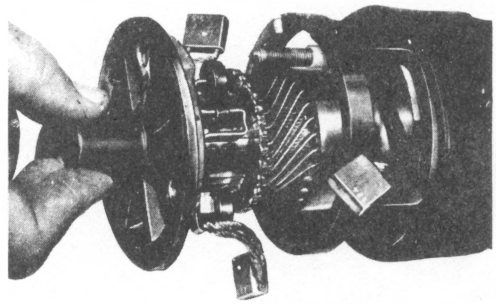


Fig. M:24 Refitting commutator end bracket - inertia starter

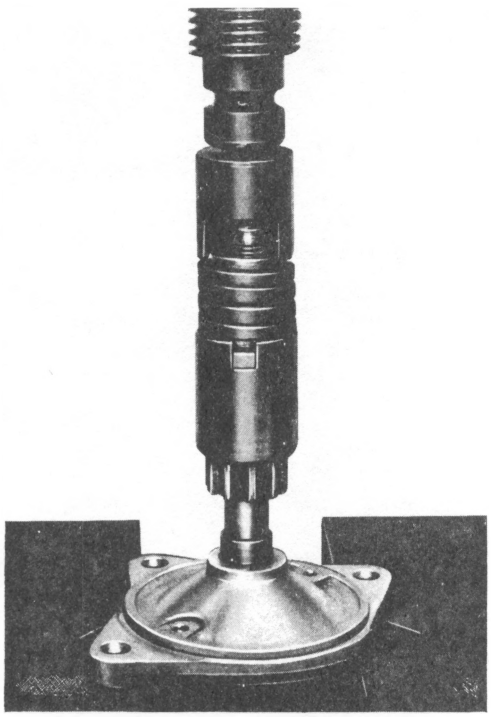


Fig. M:26 Compressing drive spring - inertia starter

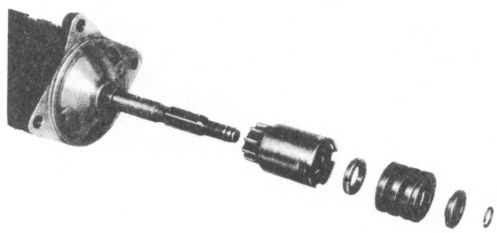


Fig. M:25 Drive assembly components - inertia starter

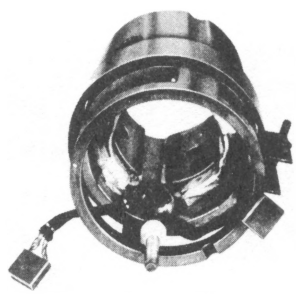


Fig. M:27 Starter frame assembly - inertia assembly

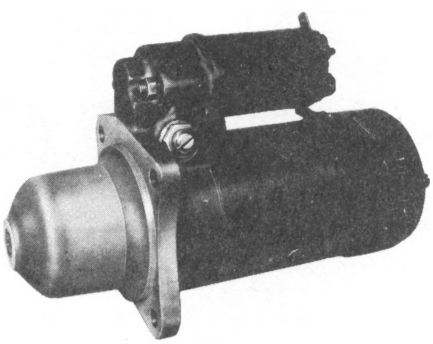


Fig. M:28 Lucas 3.5 G pre-engaged starter

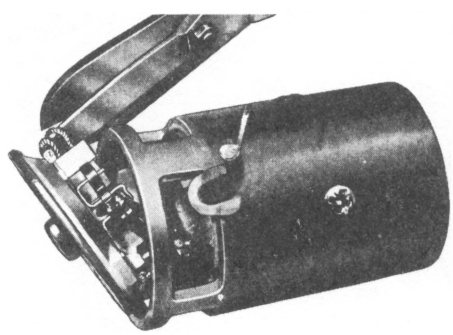


Fig. M:29 Cutting off brush leads - Lucas M 3.5 G

10. Open the eyelet, insert the replacement brush lead, squeeze the eyelet closed and solder the connection.

11. To renew the insulated brushes on the field coils, unsweat the brush leads from the terminal eyelet on the field coil connection, or cut the brush leads approx. 7 mm (0.25 in) from the field coils. If disconnected at the eyelet, open the eyelet and insert the replacement brush leads, one from each side of the eyelet, squeeze the eyelet closed and resolder the connection. If the leads were cut off, solder the new brush leads to the ends of the copper wire still attached to the field coils.

NOTE: The insulated brushes have longer leads than the earth brushes, and also have a braided covering.

12. Check the brushes for freedom of movement in their holders. If necessary, clean the brushes and holders with a clean file.

13. Check the brush spring tension, using a pull-type spring scale. Hook the spring scale on the end of the brush spring and measure the pull required to lift the spring clear of its holder. The tension should be 420 grams (14.7 oz). If low, new springs must be fitted.

14. Check that the insulator band is fitted between the frame and the end of the field coils, and that the insulating bush for the field terminal post is fitted to the commutator end plate. Pass the insulated brushes out through the aperture in the frame.

15. Check that the thrust washer is fitted on the end of the armature shaft. Fit the earthed brushes in their respective holders on the end plate, and assemble the end plate to the starter frame. Ensure that the locating dowel on the plate correctly engages the notch on the frame (Fig. M:24). Fit the through-bolts, and tighten securely.

16. Fit the insulated brushes in their respective holder. Press the brushes down onto the commutator, and lift the brush springs into position on top of the brushes. Refit the brush cover bands over the brush apertures, and tighten the clamp screw.

Drive Pinion

17. If difficulty is experienced with the starter motor pinion not meshing correctly with the ring gear, it may be that the drive assembly required cleaning. The pinion barrel assembly should move freely on the screwed sleeve. If there is dirt or other foreign matter on the sleeve, it must be washed off with paraffin. Don't use grease on the drive assembly drive spring and spring

18. Compress the pinion assembly drive spring and spring cup, using a suitable clamping device (e.g. Bendix Spring Compressor Tool), and remove the jump ring from the end of the armature shaft (Fig. M:14).

19. Release the damping device, and remove the spring cup, drive spring, thrust washer and drive pinion assembly from the shaft (Fig. M:25). It may be necessary to depress the pinion assembly and turn it slightly to disengage it from the shaft splines.

NOTE: The pinion and barrel is serviced as a complete assembly with the screwed sleeve, and no attempt should be made to dismantle the pinion assembly.

20. Fit the new pinion assembly onto the armature shaft, with the pinion teeth towards the starter motor.

21. Assemble the thrust washer, drive spring and spring seat on the shaft, compress the drive spring and seat, and fit the jump ring. Ensure that the ring is correctly seated.

Dismantle

22. Remove the commutator end plate, as described in "Brush Gear". Withdraw the armature and drive end bracket from the starter frame.

23. Remove the drive pinion assembly, as described above, and withdraw the drive end bracket from the armature shaft.

24. Clean the frame, field coils, armature, drive assembly and end bracket, with a brush or air line. Wash all other parts in solvent, and dry thoroughly.

Inspection

Field Coils

25. Check the field coils visually for burned or broken insulation, and for broken or loose connections. Also check the field brush connections and the brush lead insulation.

26. Test the field coils for continuity, by connecting a 12 volt battery and test lamp in series between each of the field brushes and the field terminal.

27. The lamp will light if continuity between the brushes and field coils is satisfactory. If it does not light, this indicates that part of the field coils are open-circuited, and the coils must be replaced. Lighting of the lamp does not necessarily indicate that the field coils are in order, as it is possible that a field coil may be grounded to a pole shoe or the starter frame.

28. Test the insulation of the field coils, by connecting a 110 volt. A.C. mains supply and 15 watt test lamp in series between one of the brushes and a clean part of the starter frame.

29. Care should be taken to ensure that neither of the brushes contact the frame during the test. The test lamp should not light. If it does, this indicates that the coils are earthed to the frame, in which case the field coils must be replaced.

Armature

30. Check the outside surface of the armature for signs of fouling the pole shoes, indicating either worn bearings or a distorted armature shaft.

31. Check the armature in a lathe, and if found to be out-of-true, it should be replaced. If the shaft is satisfactory renew the bearings in both end brackets.

32. Clean the armature with a petrol-moistened cloth. Inspect the commutator surface for pits or burned spots. If the commutator is in good condition, the surface will be smooth and dark grey in colour.

33. If pits or burned spots are present, clean the surface of the commutator, by polishing carefully with very fine glass paper. On no account must emery cloth or similar abrasive be used. Skimming of the commutator will not normally be required, but if the surface is badly worn the copper commutator may be skimmed. The skimming operation should be entrusted to an Electrical Specialist.

NOTE: The commutator is of the moulded type, and the insulation slots between the segments must not be undercut.

34. Inspect the armature windings visually for broken or burned insulation and unsoldered connection. Indications of a short circuit in the armature coils are discolouring of any one or two coils and a blackening of two or more commutator segment. An open circuit will cause burned spots between the commutator segments.

35. Test for open circuit in the commutator segments or the armature windings, using a 12 volt battery and voltmeter connected in series with a pair of test prods.

36. Place the prods on each pair of adjacent segments in turn and note the voltmeter readings. If the armature is in good condition, all the readings will be similar. If a low or zero reading is obtained between any pair of segments, one or more adjacent coils are open circuited.

37. Test the insulation of the armature windings, using a 110 volt. A.C. mains supply and 15 watt test lamp connected between the armature shaft and each of the commutator segments in turn. The lamp should not light. If it does, the insulation is defective and the armature must be replaced.

38. A 12 volt battery and voltmeter may be used for the

1. *Brush spring*
2. *Earth brushes*
3. *Through bolts*
4. *Commutator*
5. *Field connecting strap*
6. *Solenoid switch*
7. *Return spring*
8. *Engagement lever*
9. *Rubber grommet*
10. *Eccentric pivot pin*
11. *Drive end bush*
12. *Drive end bracket*
13. *Jump ring*
14. *Drive pinion*
15. *Drive end clutch assembly*
16. *Field coils*
17. *Pole shoes*
18. *Starter frame*
19. *Field brushes*
20. *Commutator end bracket*
21. *Brush inspection cover*

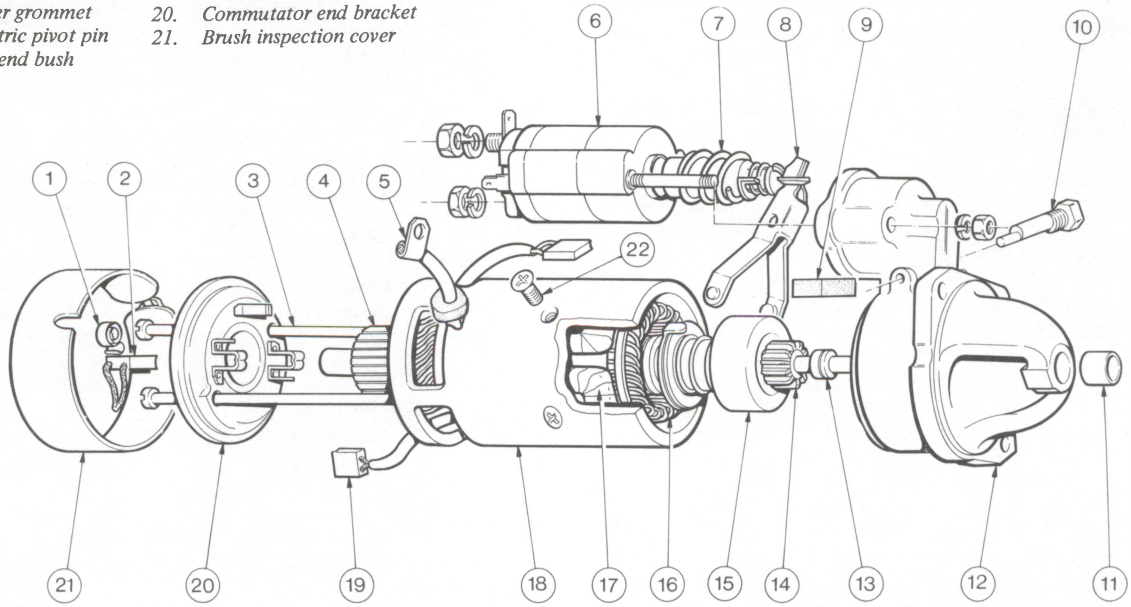


Fig. M:30 Exploded view of Lucas M 3.5 G pre-engaged starter

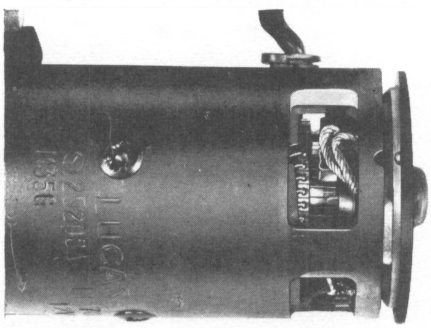


Fig. M:31 Refitting commutator end plate - Lucas M 3.5 G

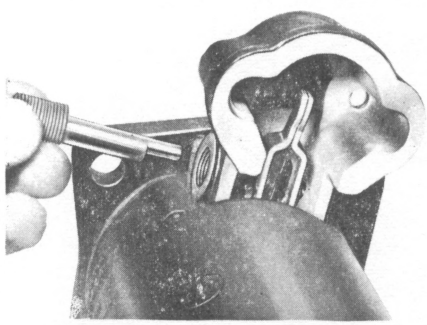


Fig. M:32 Removing eccentric pivot pin - Lucas M 3.5 G

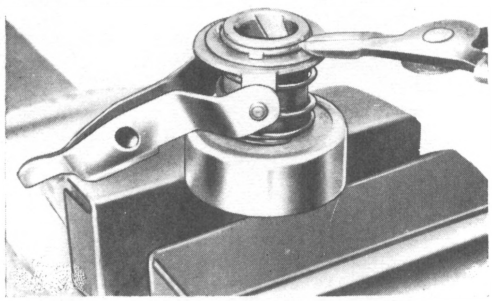


Fig. M:33 Removing engagement lever retaining circlip - Lucas M 3.5 G

Fig. M:34 Clutch and drive pinion assembly components - Lucas M 3.5 G

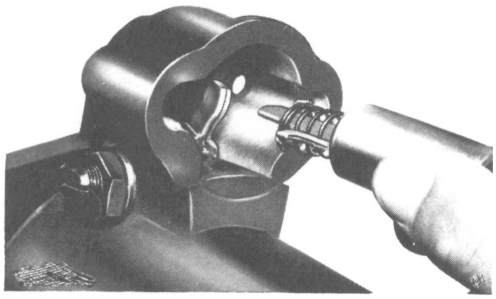


Fig. M:35 Installing solenoid plunger assembly - Lucas M 3.5 G

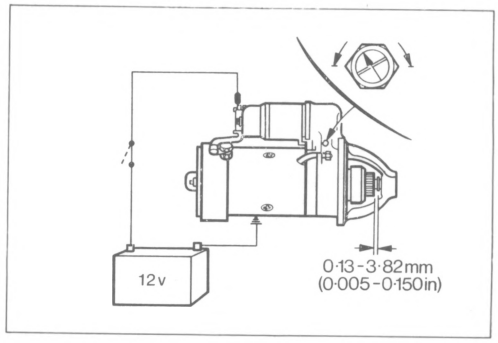
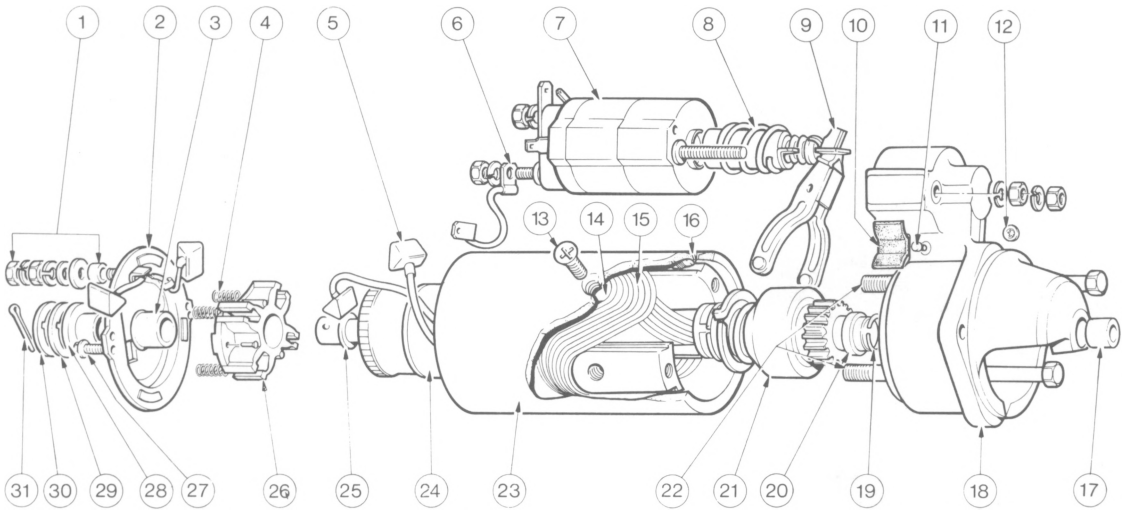


Fig. M:36 Adjusting drive pinion clearance - Lucas M 3.5 G



1. *Terminal nuts and washers*
2. *Commutator end bracket*
3. *Commutator end bush*
4. *Brush spring*
5. *Field brushes*
6. *Connecting strap*
7. *Solenoid switch*
8. *Plunger return spring*
9. *Engagement lever*
10. *Rubber sealing block*
11. *Pivot pin*
12. *Pin retaining clip*
13. *Pole piece retaining screw*
14. *Screw location*
15. *Field coils*
16. *Pole shoe*
17. *Drive end bracket*
18. *Drive end bracket*
19. *Jump ring*
20. *Ring retaining collar*
21. *Clutch and drive assembly*
22. *Bolts*
23. *Starter frame*
24. *Armature*
25. *Thrust washer*
26. *Brush box moulding*
27. *Screw*
28. *Thrust plate*
29. *Shim washer*
30. *Plain washer*
31. *Split pin.*

Fig. M:37 Exploded view of Lucas M 3.5 pre-engaged starter

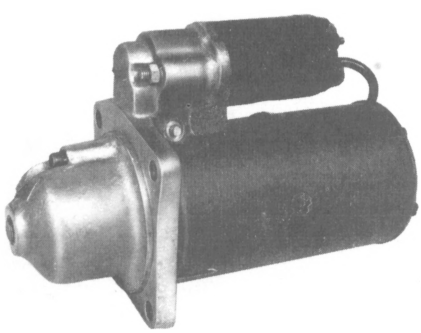


Fig. M:38 Lucas M 3.5 J starter motor

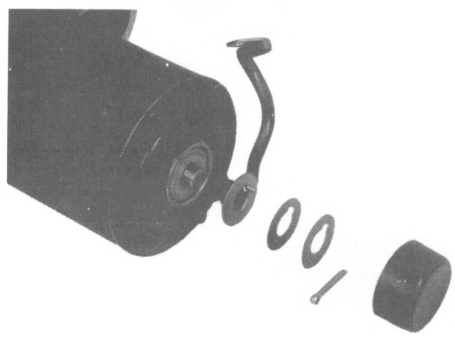


Fig. M:39 Armature shaft thrust plate and shims - Lucas M 3.5 J

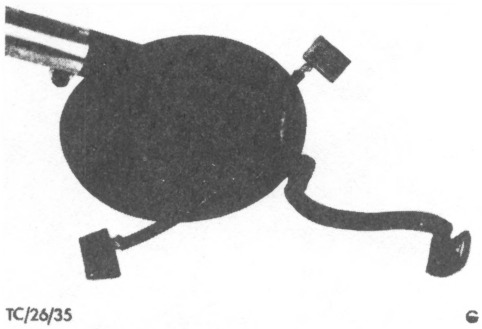


Fig. M:40 Replacing end plate brushes - Lucas M 3.5 J

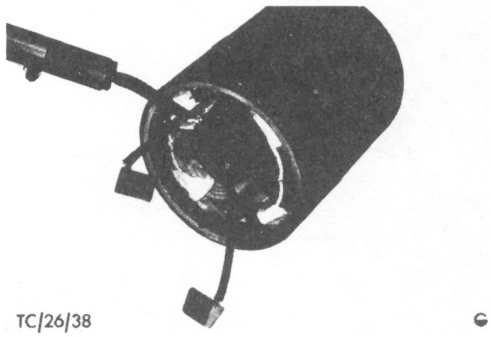


Fig. M:41 Replacing field brush - Lucas M 3.5 J

Fig. M:42 Removing engagement lever pivot pin - Lucas M 3.5 J

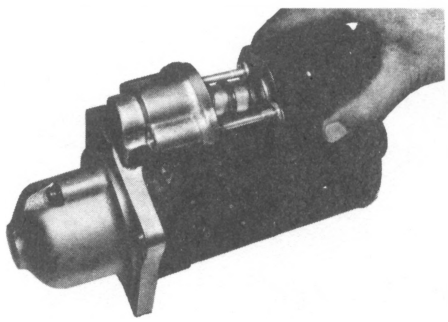


Fig. M:43 Assembling solenoid switch and plunger - Lucas M 3.5 J

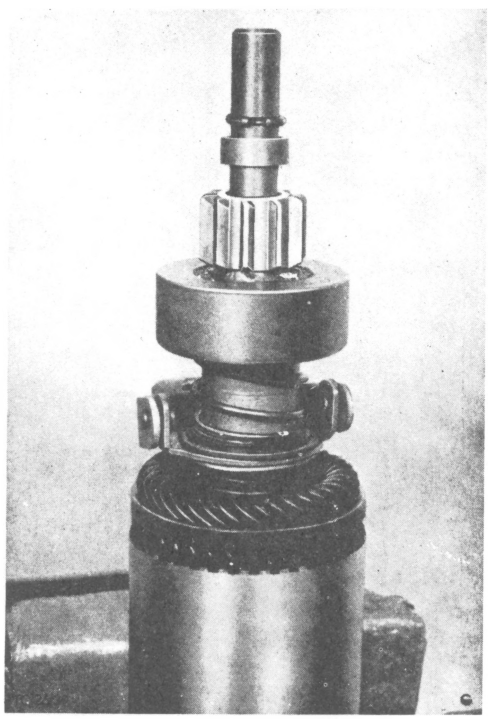


Fig. M:44 Clutch and drive pinion assembly - Lucas M 3.5 J

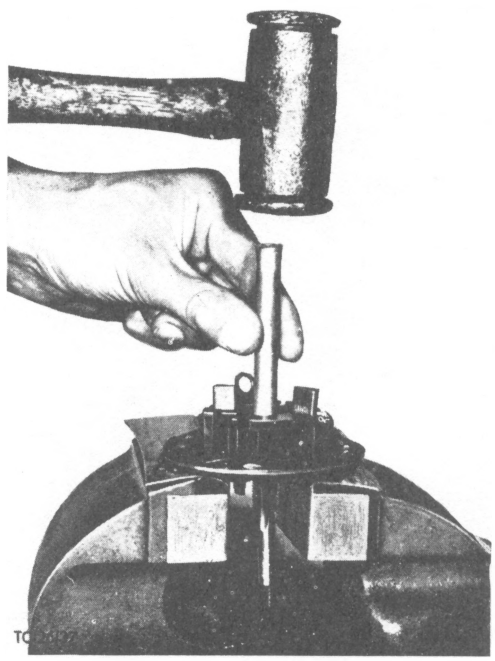


Fig. M:45 Removing commutator end bush - Lucas M 3.5 J

test instead of the mains supply and test lamp. In this case there should be no readings on the voltmeter. If a reading is obtained, one of the armature coils is grounded.

Bearings

39. Both end brackets are fitted with self-lubricating porous bronze bearing bushes. If worn or damaged, the bushings should be replaced. New bushes must be soaked in clean engine oil for a minimum period of 24 hours prior to fitting. Once fitted, the bushes must NOT be reamed, otherwise the self-lubricating qualities will be impaired.

40. The bush in the drive end bracket can be pressed out while supporting the housing.

41. Remove the bush in the commutator end bracket, by drilling out the two rivets securing the brush box moulding, as they also secure the bearing retaining plate.

42. Remove the felt seal. Screw a suitable size tap a few turns into the bush from the outside of the bracket, and withdraw the bush and tap.

43. Press the new bushes into position, using a suitably dimensioned shouldered polished mandrel. At the commutator end bracket, fit the felt sealing ring and retainer plate, and secure along with the brush box moulding, using two new rivets.

Reassembly

44. Fit the drive end bracket on the armature shaft and reassemble the drive pinion assembly, as described previously.

45. Fit the drive end bracket and armature to the starter frame. Install the commutator end plate, as described under the heading "Brush Gear".

LUCAS 3.5 G PRE-ENGAGED STARTER

Remove - Refit

1. Jack up the car, and support on stands. Disconnect the battery earth lead. Disconnect the starter cables at the starter solenoid switch. Remove the mounting bolts, and withdraw the starter motor.

2. Refit the starter motor in the reverse order of removal On cars with automatic transmission, the transmission dipstick tube bracket is mounted under the starter side mounting bolt. Tighten the middle mounting bolt first.

Brush Gear

3. Inspect the brush gear and, if necessary, replace the brushes in a similar manner as described for the LUCAS INERTIA STARTER. However, in this case, removal of the commutator end plate is simplified, as the field coil connection to the solenoid is by means of a flexible strap which passes through a notch at one of the brush access apertures.

4. Check the insulated brush holders with a battery and test bulb, or, if available, a multimeter, to ensure that they are not earthing.

Dismantling

5. Remove the commutator end plate, as described above. Disconnect the field connecting strap at the solenoid switch terminal.

6. Remove the two nuts and washers securing the solenoid to the drive end bracket, and detach the solenoid and plunger spring.

7. Lift the solenoid plunger clear of the pinion engagement lever and withdraw from the housing. Separate the starter frame from the drive end housing and armature.

8. Remove the rubber grommet located in the drive end bracket at the solenoid mounting flange. Remove the locknut from the pinion engagement lever pivot pin and withdraw the eccentric pin (Fig. M:32).

9. Withdraw the armature and pinion assembly, together with the pinion engagement lever, from the drive end housing. Remove the thrust washer from the rear end of the armature shaft.

10. Hold the armature (suitably protected) in a vice and tap down the jump ring retaining collar (Fig. M:57). Remove the jump ring with circlip pliers and remove the retaining collar from the shaft (Fig. M:58).

11. Withdraw the drive pinion assembly. Remove the circlip unit, and detach the lever, large washer and spring (Fig. M:33).

12. Clean the starter frame, field coils, armature, drive pinion assembly, end brackets and solenoid switch with a brush or air line. Wash out all other parts in solvent and dry thoroughly.

Inspection

1. Field Coils:
   See "LUCAS INERTIA STARTER".
2. Armature:
   See "LUCAS INERTIA STARTER".

Bearings

3. Both end brackets are fitted with self-lubricating porous bronze bearing bushes. If worn or damaged, the bushings should be replaced.

4. New bushes must be soaked in clean engine oil for a minimum period of 24 hours prior to fitting. Once fitted, the bushes must NOT be reamed, otherwise the self-lubricating qualities will be impaired.

5. The bush in the drive end bracket can be pressed out while supporting the housing.

6. Remove the bush in the commutator end bracket, by screwing a suitable size of tap a few turns into the bush, then withdrawing the bush and tap. Press the new bushes into position, using a suitably shouldered mandrel.

Drive Pinion Assembly

7. Check the pinion teeth for chipping or wear. Check that the pinion assembly moves freely round and along the armature shaft splines without any roughness or tendency to bind. Slight scoring on the shaft spiral threads may be removed by filing.

8. Should the assembly be worn or in any way be defective, it must be replaced. The drive pinion and clutch assembly are serviced as an assembly, and no attempt should be made to separate them.

9. Lubricate all moving parts liberally with Silicon Grease before fitting the pinion.

10. Inspect the pinion engagement lever and lever pivot pin for wear, and replace as necessary.

Reassembly

11. Refit the large washer, spring engagement lever and bush to the drive pinion and clutch unit, and secure with the circlip.

12. Assemble the drive pinion assembly and jump ring retaining collar to the armature shaft. Fit a new jump ring and pull the retaining collar up and over the ring (Fig. M:59).

13. Position the armature and pinion assembly in the drive end bracket, and secure the engagement lever with the eccentric pivot pin.

1. *Commutator end bracket*
2. *Commutator*
3. *Solenoid switch*
4. *Engagement lever*
5. *Drive end bracket*
6. *Clutch and drive assembly*
7. *Pole shoe*
8. *Starter frame*
9. *Armature*
10. *Field brushes*
11. *Brush box moulding*

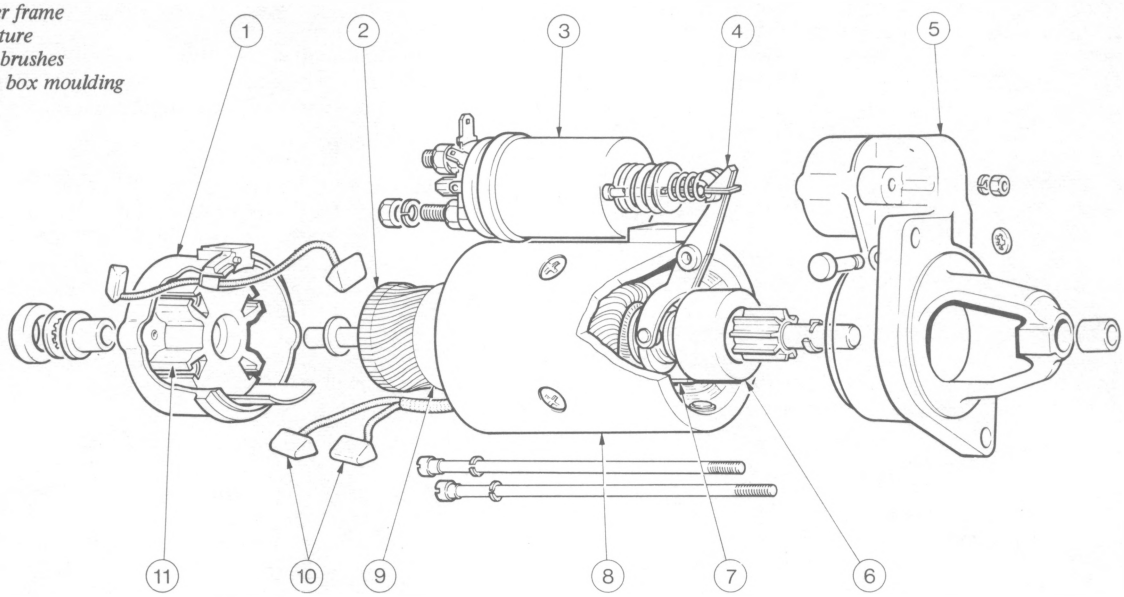


Fig. M:46 Exploded view of Lucas M100 pre-engaged starter

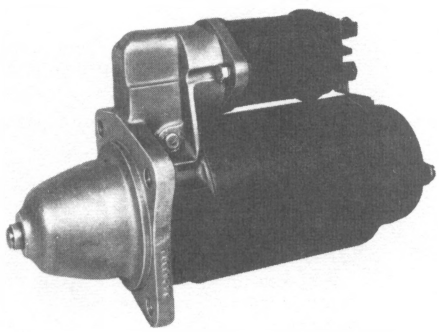


Fig. M:47 Lucas M100 pre-engaged starter

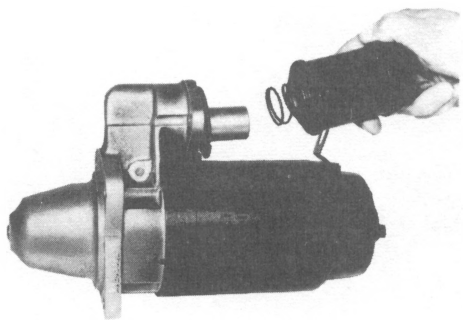


Fig. M:48 Removing solenoid - Lucas M100

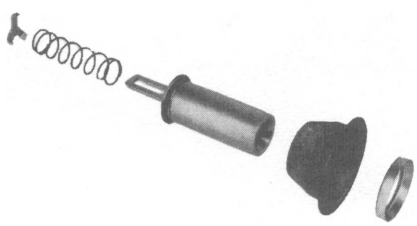


Fig. M:49 Solenoid plunger assembly - Lucas M100

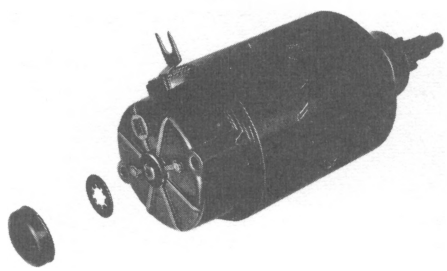


Fig. M:50 Armature shaft retaining ring and cover - Lucas M100

14. Locate the rubber grommet in the drive end housing at the solenoid mounting flange. Assemble the starter frame to the drive end bracket, ensuring that the locating dowel on the bracket correctly engages the notch in the frame.

15. Assemble the brush gear and fit the commutator end bracket as described previously in "Brush Gear".

16. Locate the solenoid plunger in the pinion engagement lever and the spring over the plunger (Fig. M:35). Position the solenoid over the plunger and secure with the two nuts and spring washers.

17. Adjust the pinion engagement lever, by energising the solenoid with a 6 - 8 volt supply (6 - 8 volts is used to prevent the solenoid overheating). Turn the pivot pin with a screwdriver inserted in the recess until a clearance of 0.13 - 0.38 mm (0.005 - 0.015 in) is obtained between the pinion face and the thrust collar (Fig. M:36).

18. The arc of adjustment is 180° and the arrow on the pivot pin must be set to point towards the arrow that is out on the drive end bracket. Fit the locknut to the eccentric pivot pin and lock the pin in position. Recheck the setting. Finally, reconnect the field connecting lead to the solenoid terminal.

LUCAS M 3.5 J PRE-ENGAGED STARTER

Removal and Installation

1. Removal and installation of the starter motor is carried out in similar manner as described for the LUCAS M 3.5 G Pre-Engaged STARTER.

Brush Gear

2. Disconnect the field connecting strap at the solenoid switch terminal. Detach the plastic cover at the rear of the starter motor. Extract the split pin from the end of the armature shaft. and remove the shim washers and thrust plate from the shaft (Fig. M:39).

3. Remove the two retaining screws and detach the commutator end plate from the starter frame. Withdraw the two field brushes from their holders in the end plate.

4. Inspect the brushes for wear. Brushes which are worn to, or approaching the minimum length of 9.5 mm (0.375 in) must be renewed as a set.

5. Check the commutator contact face for oil contamination. If present, the brushes must be renewed. If the commutator is blackened or dirty, clean it with a petrol-moistened cloth. If there is evidence of burning, this can be cleaned off with very fine glass paper. On no account must emery cloth or similar abrasive be used.

6. To renew the brushes, cut the brush leads away from the terminal post.

7. Using a file or hacksaw, make a groove in the head of the terminal, deep enough to accommodate the new brush leads. Solder one long and one short brush lead into the terminal groove ensuring that the different lengths of leads are fitted in their correct respective positions.

8. Ensure that the insulated sleeves on the new brush leads provide maximum coverage consistent with satisfactory soldering.

9. Fit the brushes into their respective holders, and check for freedom of movement.

NOTE: Sticking brushes can usually be freed by cleaning the brushes and holders with a petrol-moistened cloth or, if necessary, by lightly polishing the brush sides on a smooth file.

10. Check the brush spring pressures with the brushes fitted in their holders. Press on top of the brush with a push-type spring gauge until the top of the brush protrudes about 1.6 mm. (0.06 in), above the brush box moulding. A reading of approx. 800 grammes (28 oz) should be obtained. If the spring pressures are appreciably incorrect, the springs must be renewed.

11. Ensure that the thrust washer is in place on the rear end of the armature shaft. Fit the brushes in their respective holders, and attach the commutator end plate to the starter frame with the two retaining screws.

12. Fit the thrust plate on the armature shaft with the tab outwards, locate the shim washers on the thrust plate, and secure with a new split pin. Check the armature shaft end-float.

13. This should be 0.25 mm (0.010 in) and can be adjusted, if necessary, by altering the number of shims between the split pin and the thrust plate. Ensure that the shims are prevented from rotating separately by the split pin which should be engaged with the locking tab on the thrust plate. Reconnect the field connecting strap to the solenoid terminal.

Dismantling

14. Disconnect the field connecting strap at the solenoid terminal. Remove the two nuts and washers securing the solenoid to the drive end bracket, and detach the solenoid.

15. Lift the solenoid plunger clear of the pinion engagement lever, and withdraw the plunger and return spring assembly. Remove the rubber sealing block located between the drive end bracket and the starter frame at the solenoid mounting flange.

16. Extract the spring retaining clip from its groove in the pinion engagement lever pivot pin, and withdraw the pin from the drive end bracket (Fig. M:42).

17. Remove the two retaining bolts, and separate the drive end bracket from the starter frame and armature assembly.

18. Remove the commutator end plate, as described above. Withdraw the armature complete with the drive pinion and clutch assembly, from the starter frame.

19. Remove the thrust washer from the rear end of the armature shaft. Hold the armature, suitably protected, in a vice and tap down the jump ring retaining collar (Fig. M:58).

20. Remove the jump ring with circlip pliers and remove the retaining collar from the shaft (Fig. M:59). Withdraw the drive pinion assembly.

21. Remove the circlip securing the engagement lever to the drive pinion and clutch unit, and detach the lever, large washer and spring (Fig. M:33).

22. Clean the starter frame, field coils, armature, driven pinion assembly, end brackets and solenoid switch, with a brush or air line. Wash out all other parts in solvent and dry thoroughly.

Inspection

Field Coils

1. Check that field coils visually for burned or broken insulation, and for broken or loose connections. Also check the brush connections and the brush lead insulation.

2. Test the field coils for continuity, by connecting a 12 volt battery and test lamp in series between the field brush terminal post and the starter frame. The lamp will light if the field winding continuity is satisfactory.

3. If the lamp does not light, this indicates that either the soldered earth joint at the winding copper connector is broken, or part of the field windings are open-circuited and the coils must be replaced.

4. Before the coil insulation can be tested, the earth joint at the winding copper-connector must first be unsoldered.

5. Test the insulation, by connecting a 110 volts AC mains supply and a 15 watt test lamp in series between the field brush terminal post and the starter frame.

6. Care should be taken to ensure that neither of the

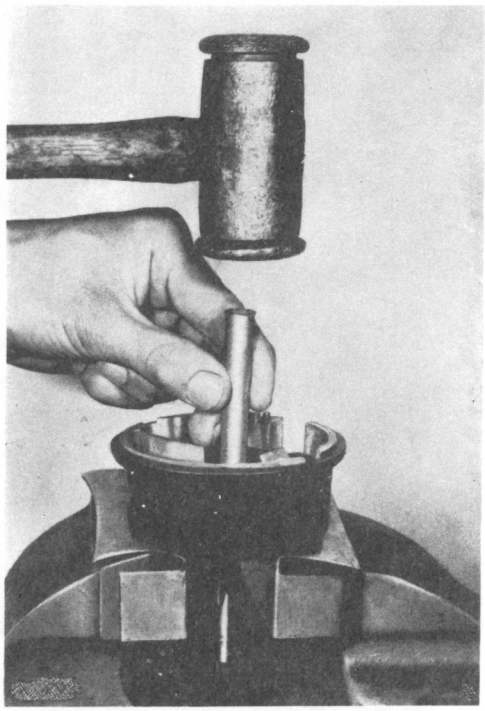
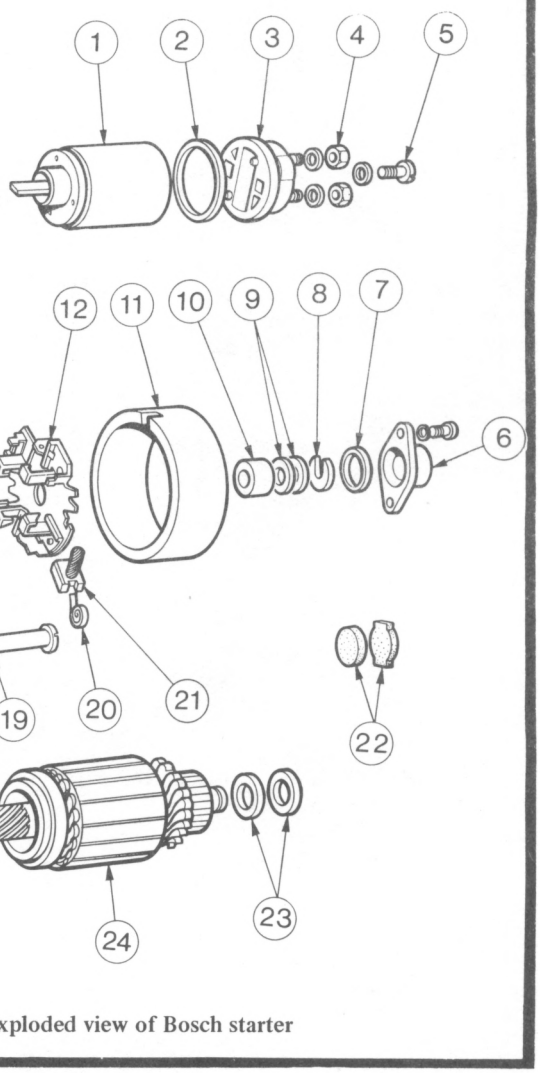


Fig. M:52 Removing commutator end bush - Lucas M100

Fig. M:51 Checking brush spring tension - Lucas M100



1. *Solenoid switch*
2. *Packing ring*
3. *Switch cover*
4. *Terminal nut*
5. *Screw*
6. *End cap*
7. *Rubber sealing ring*
8. *"U" shaped clip*
9. *Shims*
10. *Commutator end bush*
11. *Commutator end bracket*
12. *Brush plate*
13. *Starter frame*
14. *Drive end bracket*
15. *Screw*
16. *Drive end bush*
17. *Pivot pin*
18. *Engagement lever*
19. *Through bolt*
20. *Brush spring*
21. *Brush*
22. *Rubber plug and steel washer*
23. *Thrust washers*
24. *Armature*
25. *Packing rings*
26. *Clutch and drive assembly*
27. *Bush*
28. *Stop ring retainer collar*
29. *Stop ring*

Fig. M:53 Exploded view of Bosch starter

field brushes contact the frame during the test. The test lamp should not light. If it does, this indicates that the coils must be replaced.

7. Re-solder the earth joint between the winding connector and the frame, when testing is completed.

Armature

8. See "LUCAS INERTIA STARTER".

Bearings

9. See "LUCAS M 3.5 G PRE-ENGAGED STARTER".
10. Drive Pinion Assembly:
See "LUCAS M 3.5 G PRE-ENGAGED STARTER".

Reassembly

11. Refit the large washer, spring engagement lever and bush to the drive pinion and clutch unit secure with circlip.
12. Assemble the drive pinion assembly and jump ring retaining collar to the armature shaft.
13. Fit a new jump ring, and pull the retaining collar up and over the ring (Fig. M:60).
14. Assemble the commutator end plate to the starter frame, install the armature and check the end-float, as described previously in "Brush Gear".
15. Position the drive end bracket over the drive pinion and clutch assembly, ensuring that the locating dowel correctly engages the notch in the frame. Secure with the two retaining bolts.
16. Insert the pivot pin through the drive end bracket and pinion lever, secure with the spring retaining ring.
17. Locate the rubber sealing block between the drive end bracket and the yoke.
18. Fit the return spring on the solenoid plunger, engage the plunger on the pinion engagement lever and refit the solenoid.
19. Secure the solenoid to the drive end bracket with the two nuts and spring washers. Connect the field connecting strap to the solenoid terminal.

LUCAS M 100 PRE-ENGAGED STARTER

1. This type of starter motor is similar to the LUCAS M 3.5 J PRE-ENGAGED STARTER except for the solenoid plunger assembly and the brush gear. The plunger assembly incorporates a brass insert and rubber seal, details of which are shown in Fig.-M:49, and care should be taken to ensure these are correctly positioned when reassembling the solenoid to the drive end bracket.

Brush Gear

2. Remove the nut and washer securing the field terminal strap to the solenoid. Unscrew the two through-bolts from the rear of the starter motor.
3. Remove the rubber cover from the commutator end plate, carefully detach the retaining ring from the armature shaft, and withdraw the commutator end bracket.
4. Disengage the field winding brushes from the brush holders and remove the end bracket.
5. Inspect the components of the brush gear, as described for the M 3.5 J STARTER. Reassemble the commutator end bracket in the reverse order of removal.

BOSCH STARTER - Remove/Refit

Removal and Installation of the starter motor is carried out in a similar manner as described for the Lucas Inertia-type starter.

Brush Gear

1. Remove the two retaining screws and detach the protective end cap from the commutator end bracket.
2. Remove te "U" shaped clip from the armature shaft and withdraw the shims and rubber sealing ring (Fig. M:54). Unscrew the two through-bolts and withdraw the commutator end cover.
3. Withdraw the two field brushes from their holders on the brush plate and remove the brush plate complete with the two earth brushes (Fig. M:55).
4. Inspect the brushes for wear. Brushes which are worn to the minimum length of 10 mm (0.4 in) must be renewed as a set.
5. To replace the brushes, unsolder the leads from the brush holder plate and the field winding connections. Fit the new brush leads in position and solder to the original connections.
6. Check the brushes for freedom of movement in their holders.

NOTE: Sticking brushes can usually be freed by cleaning the brushes and holders with a petrol-moistened cloth or, if necessary, by lightly polishing the brush sides on a smooth file.

7. Check the brush spring pressures with a pull-type spring gauge. A reading of approx. 900 - 1300 gr (32 - 45 oz) should be obtained. If the spring pressure is appreciably outside these limits, the springs must be renewed.
8. Check the commutator for oil contamination. If present, the brushes must be renewed. If the commutator is blackened or dirty, clean it with a petrol-moistened cloth. If there is evidence of burning this can be cleaned off with very fine glass paper. On no account must emery cloth or similar abrasive is used.
9. Ensure that the steel and fibre thrust washers are in place on the end of the armature shaft.
10. Fit the brush holder plate and install the brushes in their respective holders. Position the spring ends on the brushes and check that the brushes seat correctly on the commutator.
11. Fit the commutator end cover with the rubber insulator positioned at the field winding lead. Install the two through-bolts and tighten to their specified torque.
12. Fit the rubber sealing ring shims and "U" shaped clip on the end of the armature shaft. Check the shaft end-play. This should be 0.10 - 0.30 mm (0.004 - 0.012 in).
13. If necessary, the end-play can be adjusted by altering the shim thickness below the "U" shaped clip. Fit the protective end cap and secure it to the commutator cover with the two retaining screws.

Dismantling

14. Remove the commutator end cover and brush gear, as described above. Disconnect the field connecting lead and remove the two screws securing the solenoid to the drive end housing. Unhook the solenoid plunger from the pinion engagement lever and remove the solenoid.
15. Remove the fibre washer and steel washer from the rear end of the armature shaft. Separate the starter frame from the drive end bracket and armature.
16. Release the locknut and withdraw the pinion engagement lever pivot pin from the drive end bracket. Remove the rubber plug and steel washer located at the solenoid mounting flange (Fig. M:57).
17. Withdraw the armature, drive pinion engagement lever. Lift the engagement lever off the pinion clutch sleeve.
18. Hold the armature, suitably protected, in a vice and tap down the jump ring retaining collar (Fig. M:58).

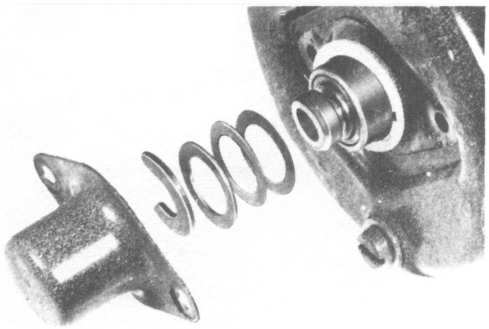


Fig. M:54 Armature shaft thrust plate and shims - Bosch

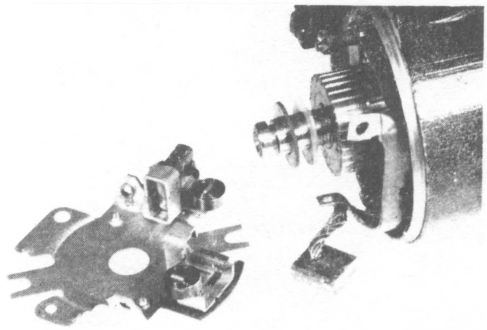


Fig. M:55 Brush assembly - Bosch

Fig. M:56 Removing solenoid switch - Bosch

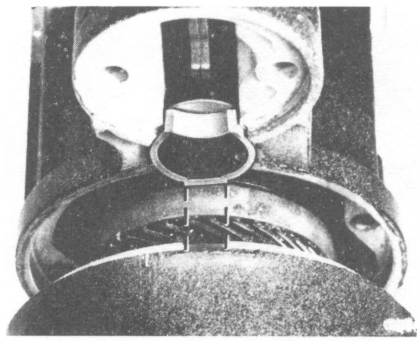


Fig. M:57 Location of rubber plug and steel washer - Bosch

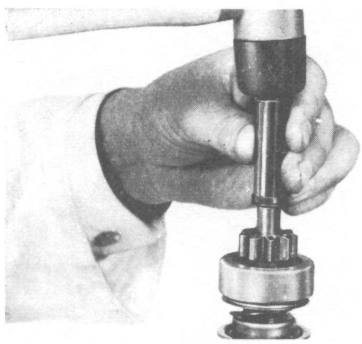


Fig. M:58 Tapping down jump ring retaining collar - Bosch

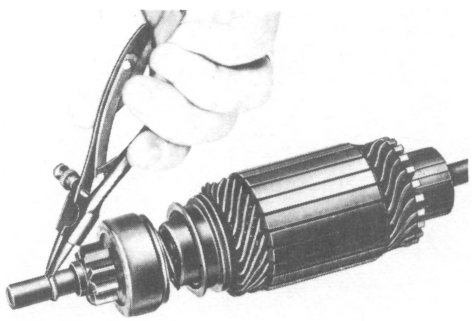


Fig. M:59 Removing jump ring - Bosch

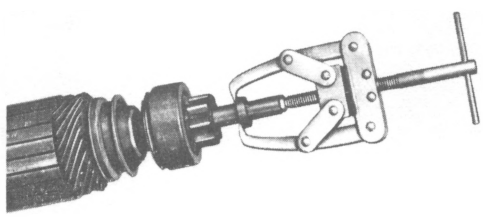


Fig. M:60 Pulling up jump ring retaining collar - Bosch

19. Remove the jump ring with the circlip pliers, and remove the retaining collar from the shaft (Fig. M:59).Withdraw the drive pinion assembly.

20. Clean the starter frame, field coils, armature, drive pinion, end brackets and solenoid switch, with a brush or air line. Wash all other parts in solvent, and dry thoroughly.

Inspection

Field Coils

1. See "LUCAS INERTIA STARTER"

Armature

2. See "LUCAS INERTIA STARTER"

3. Also check the commutator radial run-out. If this exceeds 0.3 mm (0.012 in), the surface must be skimmed true or the armature replaced. In this case the mica insulation between the commutator segments can be under-cut to a maximum depth of 0.79 mm (0.03 in) using a ground down hacksaw blade or under-cutting machine.

Bearings

4. Both end brackets are fitted with sintered bearing bushes. If worn or damaged, the bushings should be replaced. New bushes should be soaked in clean engine oil for at least one hour prior to installation.

5. Remove the old bushes by pressing them out with a shouldered mandrel. Press the new bushes into place. Again use a suitable mandrel.

Drive Pinion Assembly

6. See "LUCAS M 3.5 G PRE-ENGAGED STARTER".

Reassembly

7. Assemble the drive pinion and jump ring retaining collar to the armature shaft.

8. Fit a new jump ring and pull the retaining collar up and over the ring (Fig. M:60).

9. Assemble the armature and pinion engagement lever in the drive end housing, and install the engagement lever pin.

10. At the solenoid mounting flange, insert the steel washer, then the rubber plug with its lug towards the armature. Assemble the starter frame to the armature and drive end housing.

11. Fit the steel and fibre thrust washers on the rear end of the armature shaft. Assemble the brush gear and commutator end cover, as described previously under the heading "Brush Gear".

12. Fit the solenoid to the drive end housing, engaging the plunger loop on the end of the pinion engagement lever. Secure the solenoid with the two attaching screws. Connect the field connecting lead to the solenoid switch terminal.

Technical Data

BATTERY

Capacity: Standard equipment	38 amp. hr. at 20 hr. rate
Capacity: Optional equipment	44 amp. hr. at 20 hr. rate
	55 amp. hr. at 20 hr. rate
	66 amp. hr. at 20 hr. rate
Plates per cell 38 amp. hr.	9
44 amp. hr.	9
55 amp. hr.	11
66 amp. hr.	13
Polarity	Negative ground.
Specific gravity charged	1.270 - 1.290 at 25°C

GENERATOR

Make and Type standard equipment	Lucas C-40
optional equipment	Lucas C-40 L
Speed (Ratio to engine)	1.5:1
Max. charge C40	22 amps.
C.40L	25 amps.
Max. output C.40	264 watts.
C.40L	300 watts.
Brush length New	18.23 mm (0.718 in.)
Min.	8 mm (0.32 in)
Belt tension (total free-movement)	13 mm (0.5 in)

REGULATOR (LUCAS)

Cut-out cut-in voltage	12.6 - 13.4 volts.
drop-off voltage	9.25 - 11.25 volts.
armature to core anti-gap	0.9 - 1.1 mm (0.035 - 0.045 in)
"follow through" of moving contact	0.3 - 0.5 mm (0.010 - 0.020 in)

REGULATOR (AUTOLITE)

Cut-out - cut-in voltage	12.6 - 13.4 volts
drop-off voltage	9.25 - 11.25 volts
armature to core air gap	0.64 - 0.94 mm (0.025 - 0.037 in)
follow through of moving contact	0.38 - 0.64 mm (0.015 - 0.025 in)

LUCAS ALTERNATOR

Standard type	15 ACR
with heated rear window	17 ACR
System voltage	12
Polarity	Negative ground
Rotation (viewed from drive end)	Clockwise
Nominal rated output (at 14.0 volts & 6,000 rev/min)	
15 ACR	28 amps.
17 ACR	36 amps
Stator phases	3
Stator winding resistance (per phase)	0.133 ohms
Rotor winding resistance (at 20°C):	
15 ACR	4.33 ± 5%
17 ACR	4.165 ± 5%
Slip ring end brush length (protrusion):	
New	13 mm (0.5 in)
Min	5 mm (0.2 in)
Brush spring tension (brush flush with brush housing)	198 - 283 gr (7 - 10 oz)
Voltage regulator:	
Model	LUCAS 11 TR
Type	Solid state, internally mounted.
Regulating voltage	14.0 - 14.4 volts

BOSCH ALTERNATOR

Standard type	28 G1
- with heated rear window	35A - K1
System voltage	12
Polarity	Negative ground.
Rotation (viewed from drive end)	Clockwise.
Speed (ratio to engine)	1.1:9
Max. current.	
- 28 G1	28 amps.
- 35A - K1	35 amps.
Brush length	
- new	14 mm (0.56 in)
- min.	9 mm (0.35 in)
Brush spring tension	300 - 400 gr (10.6 - 14.1 oz)
Max. run-out of slip rings	0.03 mm (0.001 in)
Min. dia. of slip rings	31.5 mm (1.25 in)

STARTER MOTOR IDENTIFICATION

Type	Make and Model	Part No:
A	Lucas M 3.5 G Inertia	3034E - 11001 - C
B	Lucas M 3.5 G Pre-engaged	71BB - 11000 - HA
C	Lucas M 3.5 J Pre-engaged (Face commutator)	71BB - 11000 - FA
D	Lucas M 3.5 J Pre-engaged (Face commutator)	71BB - 11000 - EA
E	Lucas M 100 Pre-engaged (Face commutator)	71BB - 11000 - JA
F	Lucas M 100 Pre-engaged (Face commutator)	71BB - 11000 - KA
G	Bosch 0.7 PS Pre-engaged	71BB - 11000 - DA
H	Bosch 1.0 PS Pre-engaged	71BB - 11000 - BA

LUCAS PRE-ENGAGED TYPE STARTER (1)

Model	M 3.5 J or M 100
No. of pinion gear teeth	10
No. of flywheel ring gear teeth	135

Direction of rotation ..... Clockwise
Max. torque (at 20°C):
M 35 J ..... 0.97 mkg.
M 100 ..... 1.38 mkg
Voltage 12
Max. output:
M 35 J ..... 700 watts
M 100 ..... 750 watts
Min. brush length ..... 9,5 mm (0.37 in)
Brush spring tension ..... 480 gr (16.8 oz)
Armature end-float ..... 0.1 - 0.3 mm (0.004 - 0.012 in)

LUCAS PRE-ENGAGED TYPE STARTER (2):

Model ..... M 3.5 G
No. of pinion gear teeth 10
No. of flywheel ring gear teeth 135
Direction of rotation ..... Clockwise
Max. torque (at 20°C) ..... 1.33 mkg
Voltage 12
Max. output ..... 650 watts
Min. brush length ..... 9.0 mm (0.35 in)
Brush spring tension ..... 850 gr (30 oz)
Max. permissible out-of-round of commutator ..... 0.075 mm (0.003 in)
Min. dia. of commutator ..... 34 mm (1.34 in)
Armature end-float ..... 0.1 - 0.3 mm (0.004 - 0.012 in)

BOSCH STARTER

Type ..... pre-engaged, solenoid
Model ..... EF 0,7, EF 0.8 or GF 1.0
No. of pinion gear teeth 10
No. of flywheel ring gear teeth 135
Direction of rotation ..... Clockwise
Max. torque (at 20°C) ..... 1.1 mkg
Voltage 12
Output ..... 515 watts
Min. brush length ..... 10 mm (0.4 in)
Brush spring tension ..... 900 - 1.300 gr (32 - 45 oz)
Max. permissible out-of-round of commutator ..... 0.3 mm (0.012 in)
Min. dia. of commuator ..... 32.8 mm (1.29 in)
Armature end-float ..... 0.1 - 0.3 mm (0.004 - 0.012 in)

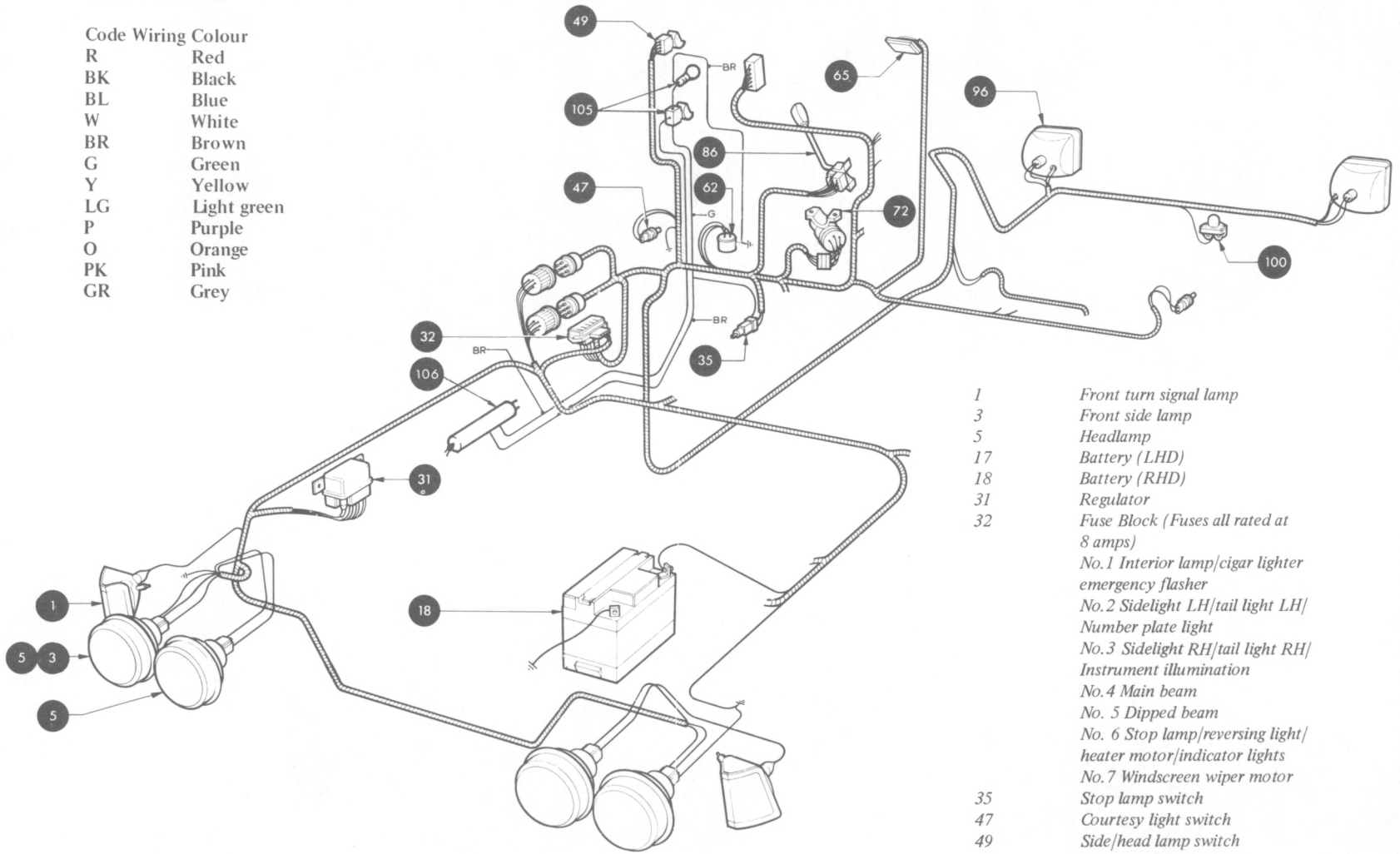
BULB CHART

Type of bulb		Number	Candle power	Watts	Type
Halogen lamps		2	–	55	Ny
Headlights (standard)		2	–	45/40	Spherical
Headlights GXL = H4		2	–	60/55	
Indicator lamps, front		2	32	21	
Indicator lamps, rear		2	32	21	
Stop lamps		2	32/4	21/5	
Reversing lamps		2	32	21	
Number plate lamps		2	4	4	
Side lamps		2	4	4	Glass socket
Pilot lamps	Standard	5	1	1.2	
	GT	4	1	1.2	
Instrument lighting	Standard	3	1	2.2	
	GT	7	1	2.2	
Interior lamps	Standard	1	–	10/6	Safitte
	with sliding roof	2	–	5	
	Estate	1	–	5/6	
	Luggage Compartment lamp	1	–	10/6	

Wiring Diagram

COLOUR CODE

Code	Wiring Colour
R	Red
BK	Black
BL	Blue
W	White
BR	Brown
G	Green
Y	Yellow
LG	Light green
P	Purple
O	Orange
PK	Pink
GR	Grey



1	*Front turn signal lamp*
3	*Front side lamp*
5	*Headlamp*
17	*Battery (LHD)*
18	*Battery (RHD)*
31	*Regulator*
32	*Fuse Block (Fuses all rated at 8 amps)*
	No.1 Interior lamp/cigar lighter emergency flasher
	No.2 Sidelight LH/tail light LH/ Number plate light
	No.3 Sidelight RH/tail light RH/ Instrument illumination
	No.4 Main beam
	No. 5 Dipped beam
	No. 6 Stop lamp/reversing light/ heater motor/indicator lights
	No.7 Windscreen wiper motor
35	*Stop lamp switch*
47	*Courtesy light switch*
49	*Side/head lamp switch*
62	*Turn signal flasher unit*
65	*Interior lamp and panel*
72	*Ignition switch*
86	*Direction indicator switch*
96	*Stop/tail/turn signal/reversing light*
100	*Licence plate lamp*
105	*Brake warning light and test switch*
106	*Brake pressure differential switch*

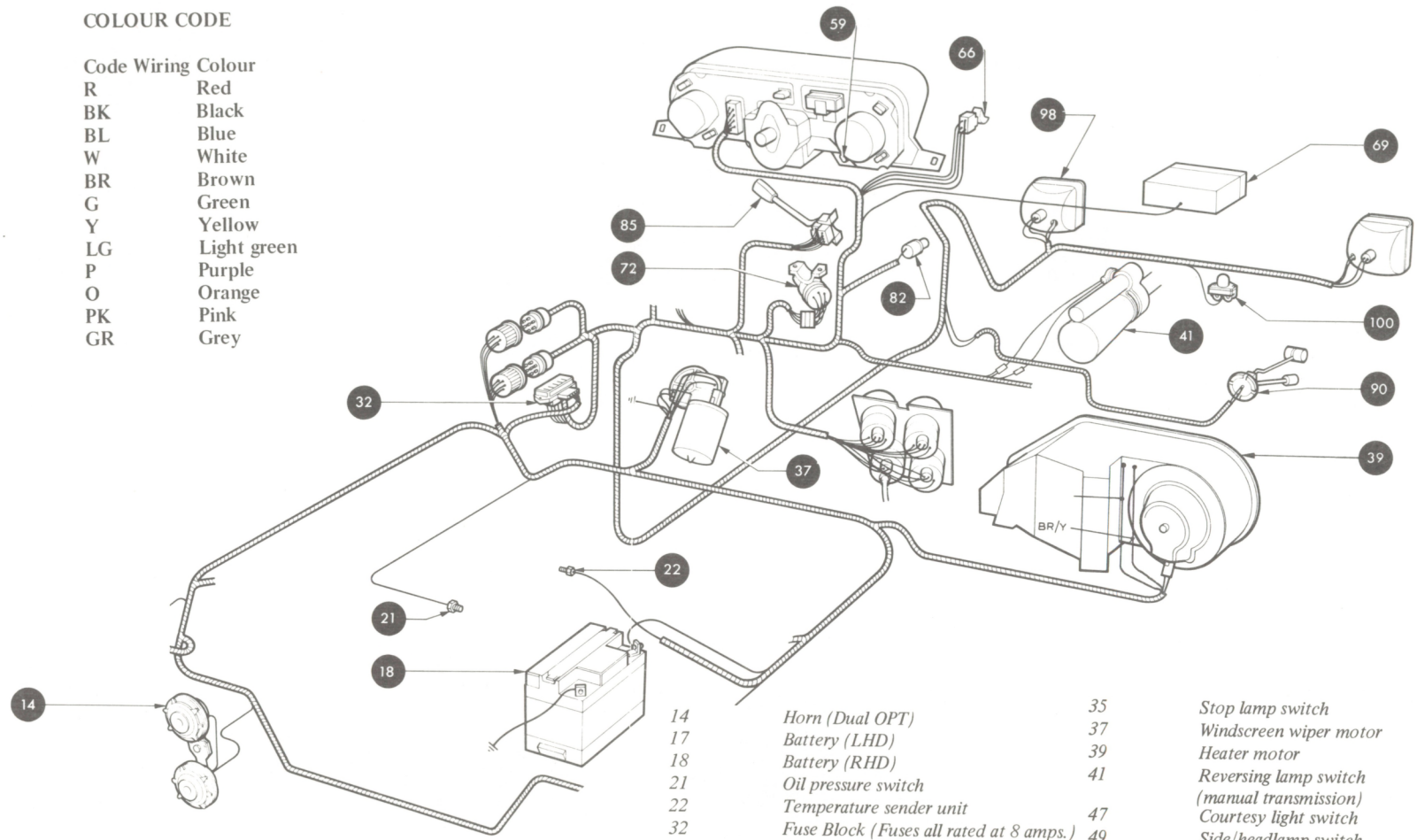
Lighting system - RHD

(Refer to page 166 for details of electrical components)

Wiring Diagram

COLOUR CODE

Code	Wiring Colour
R	Red
BK	Black
BL	Blue
W	White
BR	Brown
G	Green
Y	Yellow
LG	Light green
P	Purple
O	Orange
PK	Pink
GR	Grey



Auxiliary electrical equipment - RHD

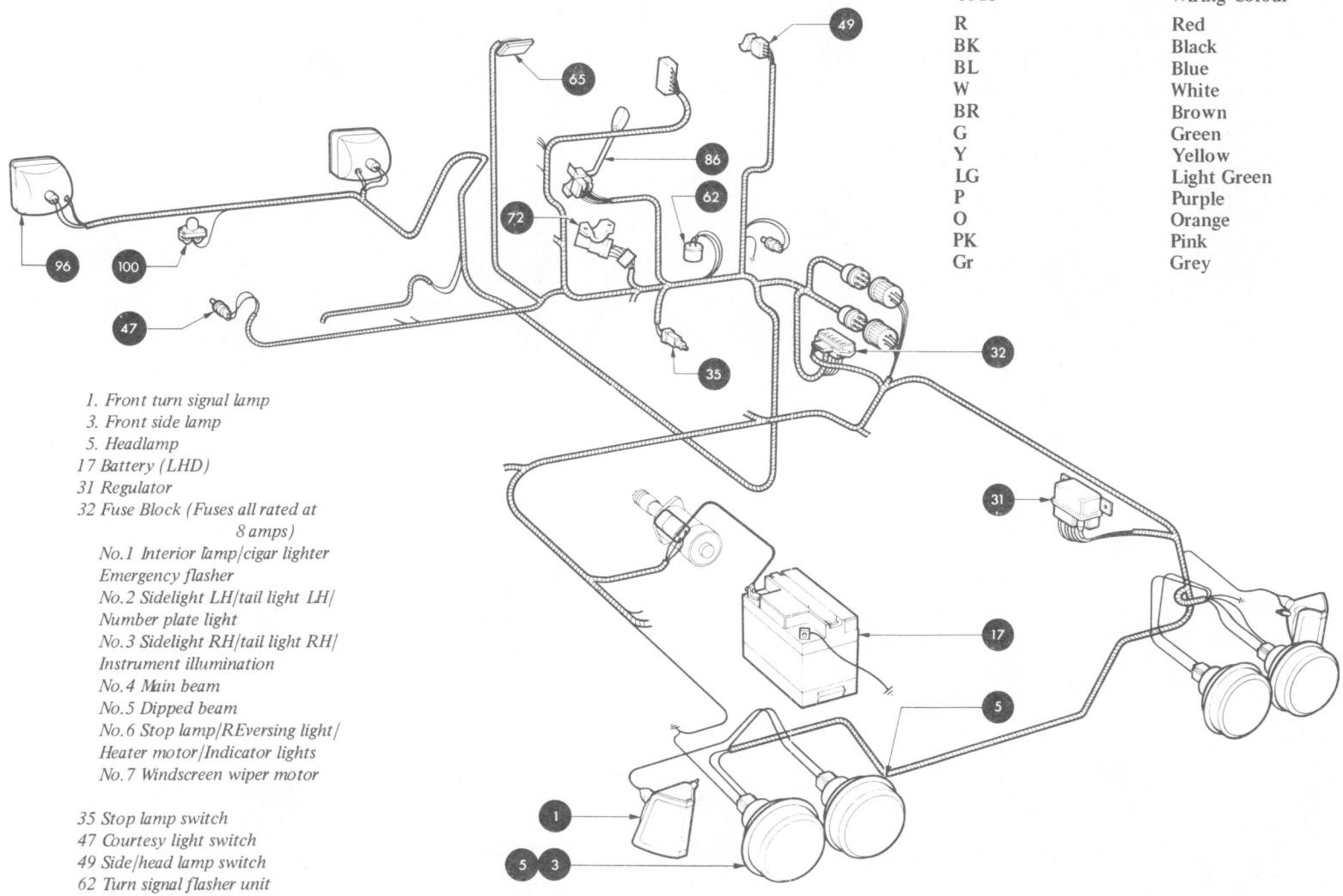
(Refer to page 166 for details of electrical components)

14	*Horn (Dual OPT)*	35	*Stop lamp switch*
17	*Battery (LHD)*	37	*Windscreen wiper motor*
18	*Battery (RHD)*	39	*Heater motor*
21	*Oil pressure switch*	41	*Reversing lamp switch (manual transmission)*
22	*Temperature sender unit*	47	*Courtesy light switch*
32	*Fuse Block (Fuses all rated at 8 amps.)*	49	*Side/headlamp switch*
	No. 1 Interior lamp/cigar lighter/ emergency flasher	59	*Alternator warning lamp*
	No.2 Sidelight LH/tail light/LH/ number plate light	62	*Turn signal flasher unit*
	No.3 Sidelight RH/ tail light RH/ instrument illumination	65	*Interior lamp and panel*
	No.4 Main beam	66	*Windscreen wiper switch*
	No.5 Dipped beam	69	*Radio (R.P.O.)*
	No.6 Stop lamp/reversing light/ heater motor/indicator lights	72	*Ignition switch*
	No. 7 Windscreen wiper motor	85	*Direction indicator switch (L.H.D.)*
		86	*Direction indicator switch (R.H.D.)*
		90	*Fuel gauge sender unit*
		98	*Stop/tail/turn signal/reversing lamp*
		100	*Licence plate lamp*

Wiring Diagram

COLOUR CODE

Code	Wiring Colour
R	Red
BK	Black
BL	Blue
W	White
BR	Brown
G	Green
Y	Yellow
LG	Light Green
P	Purple
O	Orange
PK	Pink
Gr	Grey



1. Front turn signal lamp
3. Front side lamp
5. Headlamp
17 Battery (LHD)
31 Regulator
32 Fuse Block (Fuses all rated at 8 amps)
No.1 Interior lamp/cigar lighter Emergency flasher
No.2 Sidelight LH/tail light LH/ Number plate light
No.3 Sidelight RH/tail light RH/ Instrument illumination
No.4 Main beam
No.5 Dipped beam
No.6 Stop lamp/REversing light/ Heater motor/Indicator lights
No.7 Windscreen wiper motor

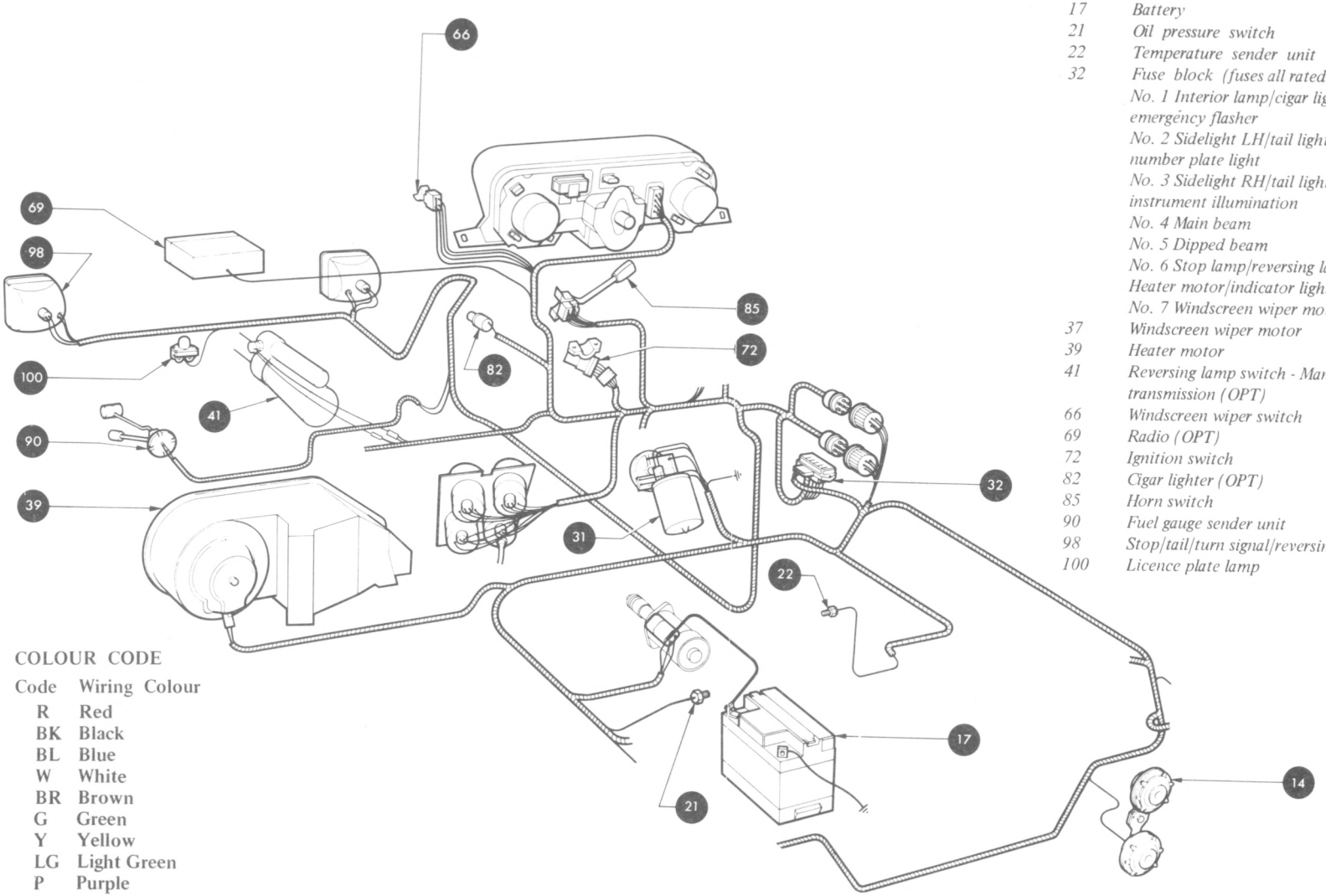
35 Stop lamp switch
47 Courtesy light switch
49 Side/head lamp switch
62 Turn signal flasher unit
65 Interior lamp and panel
72 Ignition switch
86 Direction indicator switch
96 Stop/Tail/turn signal/reversing lamp
100 Licence plate lamp

Lighting system - LHD

(Refer to page 166 for details of electrical components)

Wiring Diagram

Code	Item
14	*Horn (Duel Opt.)*
17	*Battery*
21	*Oil pressure switch*
22	*Temperature sender unit*
32	*Fuse block (fuses all rated at 8 amps* *No. 1 Interior lamp/cigar lighter/ emergency flasher* *No. 2 Sidelight LH/tail light LH/ number plate light* *No. 3 Sidelight RH/tail light RH/ instrument illumination* *No. 4 Main beam* *No. 5 Dipped beam* *No. 6 Stop lamp/reversing lamp/ Heater motor/indicator lights* *No. 7 Windscreen wiper motor*
37	*Windscreen wiper motor*
39	*Heater motor*
41	*Reversing lamp switch - Manual transmission (OPT)*
66	*Windscreen wiper switch*
69	*Radio (OPT)*
72	*Ignition switch*
82	*Cigar lighter (OPT)*
85	*Horn switch*
90	*Fuel gauge sender unit*
98	*Stop/tail/turn signal/reversing lamp*
100	*Licence plate lamp*



COLOUR CODE

Code	Wiring Colour
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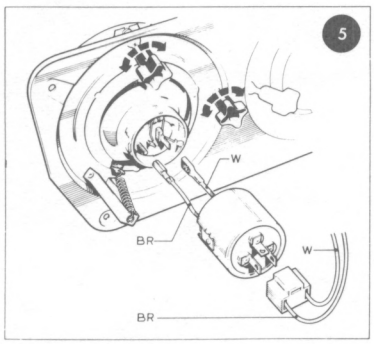
BL	Blue
W	White
BR	Brown
G	Green
Y	Yellow
LG	Light Green
P	Purple
O	Orange
PK	Pink
GR	Grey

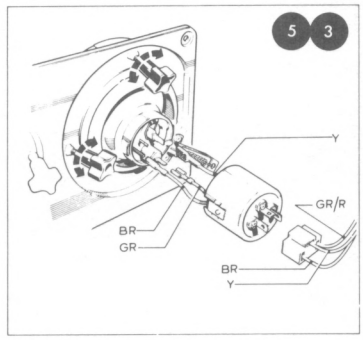
Auxiliary electrical equipment - LHD

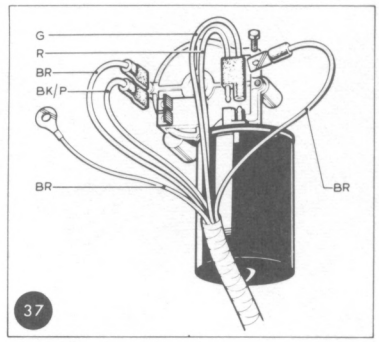
(Refer to page 166 for details of electrical components)

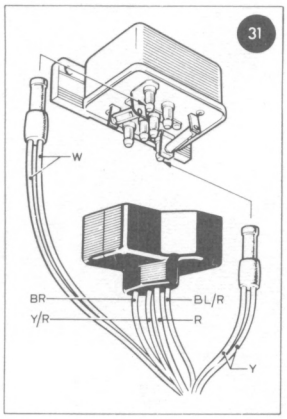
intereurope

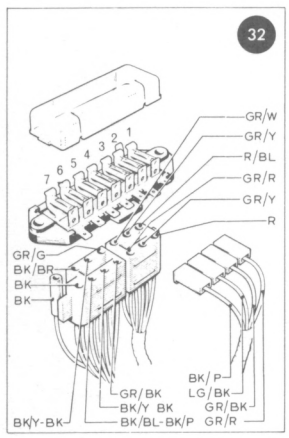
Wiring Diagram

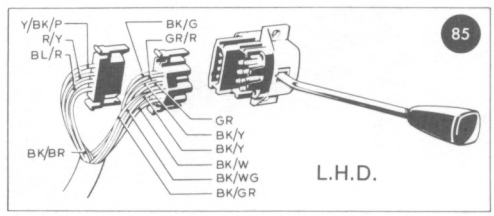


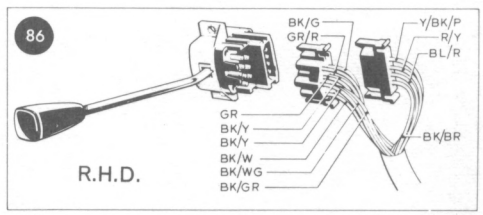


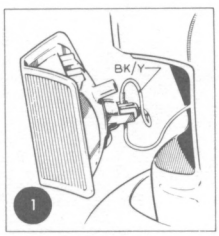


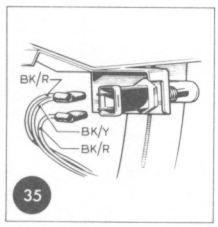


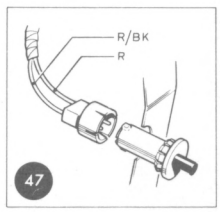


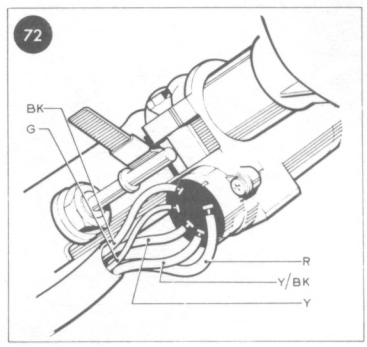


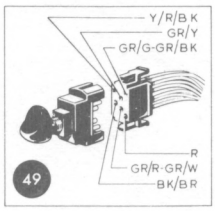


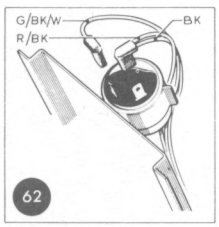


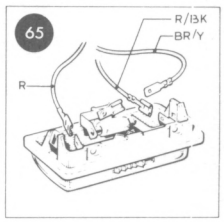


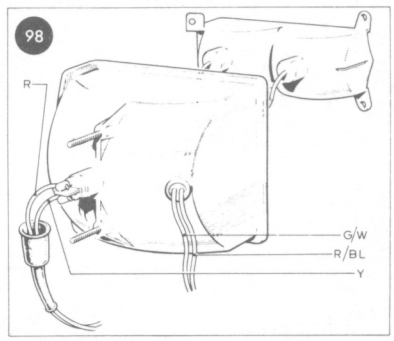


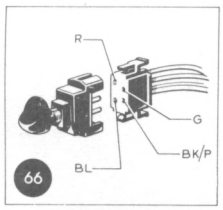












Details of electrical components and connections

(Cross-refer with diagrams on pages 162 to 165)

Trouble Shooting

Engine

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
ENGINE WILL NOT CRANK	*	*	*	*																		
ENGINE CRANKS SLOWLY	*	*	*																			
ENGINE CRANKS BUT DOES NOT START					*	*	*	*				*										
ENGINE STARTS BUT RUNS FOR SHORT PERIODS ONLY					*	*			*	*												
ENGINE MISFIRES AT LOW SPEED					*	*			*		*											
ENGINE MISFIRES AT HIGH SPEED					*	*					*	*										*
ENGINE MISFIRES AT ALL SPEEDS					*	*	*				*	*	*	*	*							*
ENGINE MISFIRES ON ACCELERATION AND FAILS TO REV					*	*			*		*											*
ROUGH IDLE					*	*		*	*	*	*		*		*	*						*
RUNS ROUGH AT HIGH SPEED					*	*	*	*	*	*	*	*	*	*	*	*						*
LACK OF POWER		*			*	*	*	*	*	*	*			*	*	*						*
POOR ACCELERATION					*	*	*	*				*		*	*	*						*
LACK OF TOP SPEED					*	*	*	*		*		*		*	*	*						*
EXCESSIVE FUEL CONSUMPTION		*			*	*									*	*						
EXCESSIVE OIL CONSUMPTION																	*	*	*	*		
PINKING					*	*																
COMPRESSION LEAK								*			*	*	*			*				*		*	*	*

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v

PROBABLE CAUSE

a Fault in the starting system – Refer to the Electrical Equipment chart for diagnosis.
b Engine oil too thick
c Stiff engine.
d Mechanical seizure
e Fault in the ignition system – Refer to the Ignition System chart for diagnosis.
f Fault in the fuel system – Refer to the Fuel System chart for diagnosis.
g Incorrect valve timing
h Compression leak.
i Air leak at inlet manifold
j Restriction in exhaust system.
k. Poor valve seating.
l Sticking valves
m Leaking cylinder head gasket.
n Worn camshaft lobes.
o Incorrect tappet clearance.
p Worn or damaged cylinder bores, pistons and/or piston rings.
q Worn valve guides.
r Damaged valve stem seals.
s Leaking oil seal or gasket.
t Incorrectly installed spark plug.
u Cracked cylinder
v Broken or weak valve springs.

REMEDIES

b Drain and refill with correct grade.
c Strip and examine engine.
d Strip and examine engine. Renew parts as necessary.
g Check timing gear. Renew parts and/or retime engine as necessary.
h Carry oit compression test to determine cause (Refer items, k, l, m, p & u in left-hand column).
i Renew gasket. Also check manifold for distortion.
j Renew exhaust system as necessary.
k Recut valve seats and grind in valves.
l Renew valves/guides as necessary.
m Renew gasket. Also check head for distortion.
n Fit new camshaft and followers.
o Adjust tappets.
p Rebore or exchange engine.
q Renew guides or ream oversize.
r Fit new seals.
s Renew oil seal or gasket.
t Check plug hole threads. Replace plug.
u Replace cylinder block or exchange engine.
v Fit new valve springs.

Lubrication System

	a	b	c	d	e	f	g	h	i	j	k	l	m	n
EXCESSIVE OIL CONSUMPTION	*	*	*	*								*	*	
LOW OIL-PRESSURE								*	*	*	*	*	*	*

PROBABLE CAUSE

a Worn or damaged cylinder bores, pistons and/or piston rings.
b Worn valve guides.
c Damaged valve stem seals.
d Leaking oil seal or gasket.
e Faulty oil pressure gauge, switch or wiring.
f Relief valve defective.
g Oil pick-up pipe strainer blocked.
h Oil filter over-flow valve defective.
i Worn oil pump.
j Damaged or worn main and/or big-end bearings.
k Incorrect grade of engine oil.
l Oil level low.
m Oil level too high.
n Oil leak on the pressurised side of the lubrication system.

REMEDIES

a Rebore or exchange engine.
b Renew guides or ream oversize.
c Fit new seals.
d Renew oil seal or gasket.
e Trace fault and rectify.
f Check and replace if necessary.
g Remove blockage
h Check and replace if necessary.
i Renew worn parts or exchange pump.
j Renew bearings.
k Drain and refill with correct grade.
l Top up oil level.
m Drain off surplus oil.
n Trace and rectify leak.

Cooling System

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
OVERHEATING	*	*	*	*	*	*		*	*	*	*	*	*	*	
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE									*						*

PROBABLE CAUSE

a Insufficient coolant.
b Drive belt slipping or broken.
c Radiator fins clogged.
d Cooling fan defective.
e Water pump defective.
f Thermostat jammed shut.
g Thermostat jammed open.
h Ignition timing too far retarded.
i Excessive vehicle load or dragging brakes.
j Internal passage in the engine and/or radiator blocked.
k Hoses blocked
l Carburettor mal-adjustment.
m Excessive carbon deposit in the cylinders.
n Insufficient engine oil or use of inferior grade of oil.
o Excessive radiator area.

REMEDIES

a Top up radiator.
b Tighten belt or renew.
c Unclog fins.
d Trace fault, rectify or renew.
e Replace water pump.
f Replace thermostat.
g Replace thermostat.
h Retime ignition.
i Unload car, check brakes.
j Flush cooling system.
k Clear blockage or replace hoses.
l Re-adjust carburettor.
m Decarbonise engine.
n Top up or drain and refill with correct grade.
o Partially blank off.

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Trouble Shooting

Ignition System

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
ENGINE CRANKS BUT DOES NOT START	*	*	*			*	*			*	*	*	*	*	*			
ENGINE STARTS BUT RUNS FOR SHORT PERIODS ONLY	*	*	*			*	*				*	*	*	*	*			
ENGINE MISFIRES AT LOW SPEED	*					*	*	*										
ENGINE MISFIRES AT HIGH SPEED		*	*	*	*	*	*			*	*	*	*		*			
ENGINE MISFIRES AT ALL SPEEDS		*	*	*	*	*	*			*	*	*	*	*	*			
ENGINE MISFIRES ON ACCELERATION AND FAILS TO REV		*	*	*	*	*	*			*	*	*	*		*			
ROUGH IDLE	*	*	*			*	*	*	*	*	*	*	*	*	*	*		*
ENGINE RUNS ROUGH AT HIGH SPEED		*	*	*	*	*	*			*	*	*	*		*	*		*
LACK OF POWER		*	*	*	*	*	*	*	*	*	*	*	*		*	*		*
POOR ACCELERATION		*	*	*	*	*	*	*	*	*	*	*	*		*	*		*
LACK OF TOP SPEED		*	*	*	*	*	*	*	*	*	*	*	*		*	*		*
EXCESSIVE FUEL CONSUMPTION		*	*	*	*	*	*	*	*	*	*	*	*			*	*	*
PINKING		*	*		*	*		*			*	*			*	*		*
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r

PROBABLE CAUSE

a Battery discharged or defective.
b Contact breaker points need cleaning or renewing.
c Incorrect contact breaker points gap.
d Contact breaker spring weak.
e Spark plugs need cleaning or renewing.
f Incorrect spark plug gaps.
g Wrong type of spark plug fitted.
h Static ignition timing incorrect.
i Coil or capacitor defective.
j Open circuit or loose connection in the L.T. circuit.
k Open circuit, short to earth or loose connection on the coil H.T. lead.
l Open circuit, short to earth or loose connection. on the spark plugs leads.
m Plug leads incorrectly connected.
n H.T. leak on coil, distributor cap or rotor, due to dirt, moisture or damage.
o Centrifugal advance not functioning correctly.
p Vacuum advance not functioning correctly.
q Worn distributor cam or distributor shaft bush.
r Using wrong grade of fuel.

REMEDIES

a Recharge or replace battery.
b Inspect points. Clean or renew as necessary.
c Reset points gap.
d Renew contact breaker set.
e Inspect plugs. Clean or renew as necessary.
f Adjust plug electrode gaps.
g Replace with plugs of correct grade.
h Check ignition timing and adjust as necessary.
i Trace fault and replace defective component.
j Check L.T. circuit leads and connections.
k. Check coil H.T. lead and connections.
l Check plug leads and connections.
m Check lead numbering
n Clean with dry lint-free rag, or replace damaged component.
o Lubricate advance mechanism, or overhaul or exchange distributor.
p Overhaul or exchange distributor.
q Overhaul or exchange distributor.
r Change to correct grade of fuel.

Fuel System

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
ENGINE CRANKS BUT DOES NOT START	*	*	*	*	*	*	*	*														
ENGINE STARTS BUT RUNS FOR SHORT PERIODS ONLY	*		*	*	*	*		*	*	*	*	*	*	*					*	*		
ENGINE MISFIRES AT LOW SPEED			*	*			*	*														
ENGINE MISFIRES AT HIGH SPEED	*		*	*			*	*						*								
ENGINE MISFIRES AT ALL SPEEDS	*	*	*	*	*	*	*	*				*	*	*								
ENGINE MISFIRES ON ACCELERATION AND FAILS TO REV	*		*	*			*	*			*	*	*	*	*	*	*	*			*	
ROUGH IDLE			*				*	*	*	*	*	*	*	*					*	*	*	*
ENGINE RUNS ROUGH AT HIGH SPEED			*				*	*			*	*	*	*					*		*	
LACK OF POWER			*				*				*	*	*	*					*		*	*
POOR ACCELERATION			*				*				*	*	*	*	*	*	*		*		*	*
LACK OF TOP SPEED			*				*				*	*	*	*	*		*		*		*	*
EXCESSIVE FUEL CONSUMPTION		*	*								*	*				*	*		*		*	*
PINKING															*					*		*
BACKFIRE			*				*			*	*		*	*								
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v

PROBABLE CAUSE

a Fuel tank empty.
b Fuel line blocked.
c Fuel pump defective.
d Blockage in carburettor.
e Air lock in fuel line.
f Fuel filter blocked.
g Carburettor needle valve jammed.
h Water in carburettor.
i Erratic fuel flow due to blockage.
j Idling speed too low.
k Incorrect setting of choke control.
l Incorrect carburettor fuel/float level.
m Carburettor icing.
n Air leak at inlet manifold.
o Incorrect grade of fuel.
p Carburettor accelerator pump defective.
q Throttle linkage mal-adjusted.
r Incorrect adjustment of idling mixture.
s Air filter clogged.
t Incorrect ignition timing.
u Carburettor piston sticking.
v Wrong carburettor jets fitted.

REMEDIES

a Fill tank.
b Blow out obstruction with compressed air.
c Replace pump.
d Clean out carburettor. Blow through jets
e Trace and bleed out.
f Clean or renew filter element.
g Free needle, or renew if necessary.
h Clean out float chamber. Blow through jets
i Trace and remove blockage
j Adjust throttle stop screw.
k Reset choke control.
l Check level setting and adjust if necessary.
m Check position of air intake spout. Change to "Winter" setting, if provided.
n Renew gasket. Also check manifold for distortion
o Change to fuel of higher octane rating.
p Overhaul pump or exchange carburettor.
q Re-adjust throttle linkage.
r Adjust mixture control.
s Clean or renew filter element.
t Check setting and adjust if necessary.
u Remove dashpot and clean piston. Top-up damper oil level
v Replace with correct jets.

Trouble Shooting

Clutch

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
CLUTCH SLIPPING (Will not engage properly)	*	*	*	*	*	*												
CLUTCH DRAG (Will not disengage properly)			*		*		*	*	*	*	*	*					*	*
CLUTCH JUDDER	*	*	*				*		*	*	*	*	*	*				
CLUTCH GRAB (On engagement)			*	*	*	*			*	*		*	*		*	*		*
CLUTCH NOISE – Squeal when depressing the pedal																*		
CLUTCH NOISE – Rattle when idling						*					*				*			
CLUTCH NOISE – Chatter on engagement										*					*			
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r

PROBABLE CAUSE

a Insufficient free-play in release linkage.
b Clutch disc facing worn or hardened.
c Grease or oil on clutch disc facing.
d Weak or broken pressure plate coil springs or diaphragm spring.
e Air in hydraulic system.
f Insufficient free-travel at clutch pedal.
g Excessive free-play in release linkage
h Misalignment of clutch housing.
i Clutch disc hub binding on splines of gearbox input shaft.
j Clutch disc facing loose or broken.
k Pressure plate mating surface warped.
l Clutch cover distorted.
m Looseness in transmission or suspension.
n Clutch disc distorted.
o Loose drive plate hub.
p Release bearing defective.
q Release arm bent.
r Low hydraulic fluid level.

REMEDIES

a Check linkage adjustment
b Replace clutch disc.
c Replace clutch disc. Trace source of leak and rectify
d Replace pressure plate assembly
e Bleed hydraulic system.
f Check pedal adjustment
g Adjust linkage, or renew worn parts
h Realign housing.
i Inspect hub and shaft splines. Relieve cause of binding, or replace parts as necessary.
j Replace clutch disc.
k Replace pressure plate assembly
l Replace pressure plate assembly
m Inspect and replace suspect components.
n Replace clutch disc.
o Replace clutch disc.
p Renew release bearing.
q Straighten or renew arm.
r Top-up fluid reservoir.

Steering

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s
STEERING STIFFNESS	*	*	*	*	*	*													
STEERING SLACK					*		*	*	*		*	*	*						
STEERING WANDER	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*	*		
WHEEL SHIMMY				*	*		*	*	*		*	*	*	*	*	*			
CAR PULLS TO ONE SIDE	*		*		*			*		*			*	*	*	*	*		
POOR RECOVERY OF STEERING WHEEL TO CENTRE	*	*	*	*	*	*												*	
EXCESSIVE OR ABNORMAL TYRE WEAR	*		*		*	*	*									*	*	*	*
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s

PROBABLE CAUSE

a Tyre pressures incorrect or uneven.
b Lack of lubricant in steering gear.
c Lack of lubrication at steering linkage ball joints.
d Incorrect wheel alignment.
e Incorrectly adjusted steering gear.
f Steering column bearings too tight or column bent or misaligned.
g Steering linkage joints worn or loose.
h Front wheel bearings worn or incorrectly adjusted.
i Slackness in front suspension.
j Road wheel nuts loose.
k Steering wheel loose.
l Steering gear mounting bolts loose.
m Steering gear worn.
n Shock absorbers defective or mountings loose.
o Road wheels imbalanced or tyres unevenly worn.
p Suspension springs weak or broken.
q Brakes pulling on one side.
r Chassis frame or suspension misaligned.
s Improper driving

REMEDIES

a Check pressures and adjust if necessary
b Add lubricant as required.
c Grease ball joints.
d Check steering geometry.
e Check and adjust if necessary.
f Determine cause and adjust or replace parts as necessary.
g Adjust or replace parts as necessary.
h Adjust or replace wheel bearings.
i Inspect and replace suspect components.
j Tighten wheel nuts to correct torque.
k Inspect splines for wear and securing nut for tightness.
l Tighten mounting bolts to correct torque
m Overhaul or replace steering gear.
n Tighten mountings or replace shock absorbers.
o Have wheels balanced.
p Renew suspension springs
q Adjust or overhaul brakes
r Have alignment checked.
s Arrange tuition on driving.

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Trouble Shooting

Brakes

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w
BRAKE FAILURE			*		*	*		*		*										*			*
BRAKES INEFFECTIVE	*	*	*	*	*	*	*	*	*	*							*		*				
BRAKES GRAB OR PULL TO ONE SIDE	*	*	*	*				*		*	*	*	*		*								*
BRAKES BIND						*									*		*	*	*		*		*
PEDAL SPONGY						*	*	*	*											*			*
PEDAL TRAVEL EXCESSIVE	*			*					*		*	*	*				*			*			*
EXCESSIVE PEDAL PRESSURE REQUIRED	*	*	*		*			*	*											*			*	*
HYDRAULIC SYSTEM WILL NOT MAINTAIN PRESSURE							*	*												*			*
BRAKE SQUEAL DEVELOPS	*	*	*	*												*		*					
BRAKE SHUDDER DEVELOPS	*	*	*	*								*	*	*		*		*					*
HANDBRAKE INEFFECTIVE OR REQUIRES EXCESSIVE MOVEMENT	*	*	*	*													*						

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w

PROBABLE CAUSE

a Brake shoe linings or friction pads excessively worn.
b Incorrect brake shoe linings or friction pads.
c Brake shoe linings or friction pads contaminated.
d Brake drums or discs scored.
e Incorrect brake fluid.
f Insufficient brake fluid.
g Air in the hydraulic system
h Fluid leak in the hydraulic system.
i Fluid line blocked.
j Mal-function in the brake pedal linkage.
k. Unequal tyre pressures.
l Brake disc or drum distorted or cracked.
m Brake back plate or calliper mounting bolts loose or looseness in the suspension.
n Wheel bearings incorrectly adjusted.
o Weak, broken or improperly installed shoe return springs.
p Uneven brake lining contact.
q Incorrect brake lining adjustment.
r Pistons in wheel cylinder or calliper seized.
s Weak or broken brake pedal return spring.
t Master cylinder defective.
u. Fluid reservoir overfilled or reservoir air vent restricted.
v Servo vacuum hose disconnected or restricted, or servo unit defective.
w Wheel cylinder or calliper defective.

REMEDIES

a Replace linings or pads.
b Replace with linings or pads of correct type.
c. Replace linings or pads. Trace source of contamination and rectify.
d Machine or replace drums or discs.
e Drain hydraulic system and refill with fresh fluid of the correct type.
f. Top up fluid reservoir.
g Bleed braking system
h Trace leak and renew seals or brake pipe
i Drain and refill system with fresh hydraulic fluid
j Inspect linkage and rectify fault
k Check pressures and adjust as necessary
l Replace disc or drum.
m Tighten loose bolts. Inspect and replace worn or suspect components.
n Adjust wheel bearings.
o Refit correctly or renew springs, as appropriate.
p Inspect brake drum for "belling" or other distortion. Machine true or replace drum
q Check brake adjustment.
r Overhaul or replace wheel cylinder or calliper
s Fit new return spring.
t Overhaul or replace master cylinder
u Syphon off excess fluid. Clear air vent.
v Inspect hose and replace if necessary. Test operation of servo unit and replace if defective.
w Replace wheel cylinder or calliper.

Electrical

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
STARTER FAILS TO OPERATE			*	*	*	*			*	*								
STARTER OPERATES BUT DOES NOT CRANK ENGINE	*	*	*			*	*	*										
STARTER CRANKS ENGINE SLOWLY	*	*	*															
STARTER NOISY IN OPERATION					*			*	*									
IGNITION WARNING LIGHT REMAINS ILLUMINATED WITH ENGINE AT SPEED			*							*	*	*						
IGNITION WARNING LIGHT FAILS TO ILLUMINATE WHEN IGN. IS SWITCHED ON	*	*							*		*		*					
IGNITION WARNING LIGHT STAYS ON WHEN IGNITION IS SWITCHED ON									*		*	*						
LIGHTS DIM OR WILL NOT ILLUMINATE	*	*									*		*	*	*	*		
BULBS BLOW FREQUENTLY AND BATTERY REQUIRES FREQUENT TOPPING-UP											*							
DIRECTION INDICATORS NOT FUNCTIONING PROPERLY	*	*							*			*		*	*		*	

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r

PROBABLE CAUSE

a Stiff engine.
b Battery discharged or defective.
c Broken or loose connection in circuit.
d Starter pinion jammed in mesh with flywheel ring gear.
e Starter motor defective.
f Starter pinion does not engage with flywheel ring gear due to dirt on pinion screwed barrel.
g Starter drive pinion defective or flywheel ring gear worn.
h Starter solenoid switch defective.
i Ignition/starter switch defective.
j Broken or loose drive belt.
k Regulator defective.
l Generator/alternator defective.
m Bulb burned out.
n Mounting bolts loose.
o Fuse blown.
p Light switch defective.
q Short circuit.
r Flasher unit defective.

REMEDIES

a Strip and examine engine
b Recharge or exchange battery.
c Check circuit leads and connections.
d Rotate starter motor shaft to release pinion.
e Overhaul or exchange starter motor.
f Clean pinion assembly with suitable solvent. Do NOT lubricate as this would attract dirt.
g Replace pinion assembly or ring gear
h Replace solenoid switch.
i Replace switch.
j Fit new drive belt and/or adjust tension
k Adjust or replace regulator.
l Overhaul or exchange unit
m Fit new bulb.
n Tighten bolts to correct torque.
o Investigate cause and rectify. Fit new fuse
p Replace switch.
q Investigate cause and rectify.
r Replace flasher unit.

Tightening Torques

ENGINE	1.3 OHV	
	lb.ft.	kgm
Main bearing cap	55/60	(7.5/8.2)
Big end bearing cap	31/35	(4.2/4.8)
Crankshaft pulley	24/28	(3.3/3.8)
Camshaft sprocket	13/15	(1.7/2.1)
Rear sealing ring carrier	13/15	(1.7/2.1)
Flywheel	50/56	(6.8/7.6)
Timing gear cover	5/7	(0.7/1.0)
Oil pump	13/15	(1.7/2.1)
Oil pump cover	5/7	(0.7/1.0)
Rocker shaft	18/22	(2.4/3.0)
Sump pan 1	3&5	(0.4/0.7)
2	6/8	(0.8/1.1)
Cylinder head 1	20/31	(2.8/4.2)
2	52/56	(7.0/7.6)
3	66/71	(9.0/9.7)
Rocker cover	3/4	(0.35/0.5)
Timing chain tensioner	5/7	(0.7/1.0)

ENGINE	1.6 OHV	1.6/2.0 OHC
Main bearing cap	64/74	(8.8/10.2)
Big end bearing cap	30/35	(4.1/4.8)
Crankshaft gear	40/43	(5.5/6.0)
Camshaft/Auxshaft sprockets	32.5/36	(4.5/5.0)
Flywheel	47/57	(6.5/7.1)
Timing gear cover	9/12	(1.3/1.7)
Oil pump	12/15	(1.7/2.1)
Oil pump cover	6.5/9.4)	(0.9/1.3)
Sump cover pan 1	0.7/1.4	(0.1/0.2)
2	4/6	(0.6/0.8)
Cylinder head 1	20/40	(4.0/5.5)
2	43/57	(6.0/7.0)
3	65/80	(9.0/11.0)
Rocker cover	3.6/5.1	(0.5/0.7)
Oil drain plug	15/20	(2.1/2.8)
Oil pressure switch	9/11	(1.2/1.5)
Ball pin valve adjustment	32.5/36	(4.5/5.0)
Spark plugs	14/20	(2.0/2.8)

COOLING SYSTEM		
Fan blades	5/7	(0.69/0.97)
Water pump	5/7	(0.69/0.97)
Thermostat housing	12/15	(1.66/2.07)

AUTOMATIC TRANSMISSION		
Torque converter	25/35	(3.5/4.1)
Converter housing	8/13	(1.1/1.8)
Extension housing	8/13	(1.1/1.8)
Front pump	8/18.5	(1.1/2.5)
Pump housing	8/18.5	(1.1/2.5)
Front servo	8/13	(1.1/1.8)
Rear servo	13/27	(1.7/3.7)
Starter inhibitor switch	4/6	(0.6/0.8)
Centre support	30/40	(4.1/5.5)
Rear brake band locknut	10/18	(1.4/2.5)
Rear adaptor	4.5/9	(0.6/0.8)
Upper valve body	20/30 lb.in	(0.25/0.35)
Valve bodies assembly	4.5/9	(0.6/1.2)
Oil sump	8/13	(1.1/1.8)
Oil drain plug	9/12	(1.4/1.6)

FUEL SYSTEM		
Fuel pump	12/15	(1.7/2.1)
Fuel tank straps	Tighten until 40/50 mm of thread is protruding through the nut.	

SUSPENSION		
	lb.ft.	kgm
*Upper Radius Arms	42/50	(5.8/6.9)
*Lower Radius Arms	42/50	(5.8/6.9)
*Coil Spring	28/34	(3.9/4.8)

To be tightened after vehicle has been lowered to ground.

REAR AXLE		
Bearing Cap Bolts	43/49	(6/6.8)
Drive Pinion	71/86	(10/12)
Crown Wheel	57/62	(8/87)
Rear Axle Housing	22/29	(3/4)
Axle Shafts to side flanges	29/36	(4/5)
Drive Shaft to Pinion flanges	43/47	(6/6.5)
Drive Shaft Centre Bearing	13/17	(1.8/2.3)

STEERING		
Steering gear	15/18	(2.1/2.4)
Track rod end	18/22	(2.5/3.0)
Coupling	12/15	(1.7/2.1)
Universal joint	12/15	(1.7/2.1)
Steering wheel	20/25	(2.8/3.4)
Track rod end	40/45	(5.5/6.4)
Track rod end ball housing	33/37	(4.6/5.2)
Pinion pre-load cover	6/8	(0.9/1.1)
Rack slipper cover	6/8	(0.9/1.1)
Pinion turning torque	5/15 lb/in	(6/17 kg/cm)

BRAKES		
Brake caliper	45/50	(6.22/6.91)
Brake disc to hub	30/34	(4.15/4.70)
Rear brake plate	15/18	(2.07/2.49)
Hydraulic unions	5/7	(0.70/1.00)
Bleed valves	5/7	(0.70/1.00)
Wheel nuts	50/65	(7.0/8.9)

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Quick Reference Data

ENGINE	1300 (OHV)	1600 (OHV)	1600 (OHC)	2000 (OHC)
Firing order	1-2-4-3	1-2-4-3	1-3-4-2	1-3-4-2
Valve clearances				
Inlet	0.010 in (0.25 mm) hot		0.008 in (0.20 mm) cold	
Exhaust	0.020 in (0.50 mm) hot		0.010 in (0.25 mm) cold	
Spark plugs type	Motorcraft AGR22	Motorcraft AGR22	Motorcraft BF22	Motorcraft BF32
gap	0.025 in (0.64 mm)			
Contact breaker gap	0.025 in (0.64 mm)			
CAPACITIES				
Engine (including oil filter)	6.16 Imp. pts (3.5 ltrs.)		6.6 Imp. pts (3.75 ltrs.)	
Gearbox	1.6 Imp. pts (0.9 ltrs.)		2.4 pts. (1.35 ltrs.)	
Automatic gearbox	11.25 Imp. pts. (6.4 ltrs.)			
Cooling system Imp. pts (ltrs.)	8.73 (4.96)	9.5 (5.4)	10.15 (5.76)	10.8 (6.13)
SPECIFIED LUBRICANTS				
Engine	SAE 10W/40, SAE 10W/50			

TYRE PRESSURES

SALOON	Up to 3 persons		Fully laden	
Tyre Size	Front	Rear	Front	Rear
6.00 - 13 4PR	23 psi (1.6 bar)	24 psi (1.7 bar)	26 psi (1.8 bar)	30 psi (2.1 bar)
6.95 - S13 4PR	23 psi (1.6 bar)	23 psi (1.6 bar)	26 psi (1.8 bar)	28 psi (2.0 bar)
165 - SR 13	26 psi (1.8 bar)	26 psi (1.8 bar)	28 psi (2.0 bar)	36 psi (2.5 bar)
185/70 - HR 13	23 psi (1.6 bar)	23 psi (1.6 bar)	26 psi (1.8 bar)	30 psi (2.1 bar)
ESTATE CAR				
6.95 - S13 4PR	23 psi (1.6 bar)	24 psi (2.4 bar)	26 psi (1.8 bar)	34 psi (2.4 bar)
165 - SR 13	26 psi (1.8 bar)	26 psi (1.8 bar)	28 psi (2.0 bar)	40 psi (2.8 bar)
185/70 - HR 13	23 psi (1.6 bar)	24 psi (1.7 bar)	26 psi (1.8 bar)	33 psi (2.3 bar)

Overall length ..... 167.7 in (4259 mm)

Overall width ..... 67.05 in (1703 mm)

Overall height ..... 53.9 in (1370 mm)

Turning circle dia.
feet (metres) 33.5 (10.2)

Track - front and rear ..... 56.0 in (1422 mm)

Wheelbase ..... 101.5 in (2578 mm)

Ground clearance ..... 5.0 in (127 mm)

Boot capacity ..... 11.8 cu.ft. (0.33 m^2) Saloons

Fuel tank capacity ..... 11.9 Imp.Gls. (54 ltrs.)

Fuel octane requirement ..... 97 (4 star) for HC
91 (2 star) for LC

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